FOUNDRY TRADE JOURNAL
EST. 1902
WITH WHICH IS INCORPORATED THE IRON AND STEEL TRADES JOURNAL
VOL. 100
No. 2067
MAY 24, 1956
Registered at the G.P.O. as a Newspaper
Offices. John Adam House, John Adam St., London, W.C.2
Single Copy, 9d. By Post 11d. Annual Subscription, Home 40/-, Abroad 45/- (Prepaid)

UNIV. OF MICHIGAN
JUN 14 1956
EAST ENGINEERING LIBRARY

Bench Type Core Blower

Machine of robust and rigid construction, designed for the rapid and economical production of small cores up to 8 lbs. in weight.

SAND RESERVOIR—arranged for quick changing.

BLOW PLATE—self venting.

CLAMPS—horizontal.

CONTROL—manually controlled operating valves.

SPECIFICATION

Daylight between machine table and blow plate	8"
Stroke of vertical piston	6"
Diameter of vertical piston	8"
Distance between horizontal clamps	variable between 3" to 9½

WRITE FOR FURTHER DETAILS

J. W. JACKMAN & COMPANY LTD.

VULCAN WORKS, BLACKFRIARS ROAD, MANCHESTER, 3

TELEPHONE: DEANSGATE 4648-9 TELEGRAMS: BLAST, MANCHESTER

YOUR SAND WITH A ROYER

England by
LEC LTD., SMETHWICK Nr. BIRMINGHAM

THE ERITH RANGE OF SANDS

Combine a variety of selected LOAMS and SILICA SANDS of guaranteed quality; suitable for every appropriate foundry requirements. In all fundamental respects they are the outstanding sands for present-day practice and are tried and proved by performance and results.

Write for illustrated Brochure and Free Samples to: ESTABLISHED 1805

J. RADISH & CO., ERITH, KENT

The Muir-Hill LH-1 is a compact, highly manoeuvrable diesel-powered loader with the unique advantage of bringing bulk material handling in confined areas out of the hand shovel into the mobile power loading class.

6ft. 6in. working ceiling, 7ft. 6in. turning radius, 4ft. 3in. width—consider these dimensions in relation to those awkward places where you have never before been able to employ any form of mechanisation—and then ask us to send you further details on the LH-1.

It does not matter what material you are handling, the LH-1 has the right bucket for the job, with a range of 14.5, 10.5 and 6.5 cu. ft. capacities, a special ore bucket and a fork lift attachment of 1,000 lbs. rated capacity with evenly distributed loads.

Send for the LH-1 Brochure!

Muir-Hill LH-1 **BUILT BY BOYDELL**

E. BOYDELL & CO. LTD. · UNIVERSAL WORKS · OLD TRAFFORD · MANCHESTER 16

dm EB 561

FOUNDRY TRADE JOURNAL

Established 1902

Vol. 100 Thursday, May 24, 1956 No. 2067

Editor:
V. C. FAULKNER, F.R.S.A., HON.M.I.B.F.

Assistant Editor: A. R. PARKES, M.I.B.F.
Commercial Editor: P. E. CARDEN.
Advertising Manager: LENNOX HOLT, M.I.B.F.
Production Manager: R. J. LOVELL.
Publisher: H. J. DWYER.
Circulation Manager: E. T. GRIFFITHS.

District Representatives:
G. P. ELLIOTT (*Northern Area*)
T. H. SMITH (*Scotland*)

PRINCIPAL CONTENTS

Technical :

PAGE

Experience with Fast-drying Bonding Materials, by A. I. Donaldson: After a few trials with rapid-drying oil-sand mixtures as a basis for cores, the Author concentrated on the CO_2 Process. Methods of sand drying, cooling and elevation are outlined and sand storage, re-use, mould coatings and sand temperatures are dealt with in their practical applications 351

Testing the Gas-content of Molten Metals in a Foundry, by B. R. Deoras, B.Sc., M.Sc., and V. Kondic, B.Sc., Ph.D.: Previous work and reports are used to check the value of the density-type gas test for rapidly estimating the gas-content of molten metals on the foundry floor . 361

National Foundry College—Its Origin and Purpose 367

Features :

Leader: **Addition not Multiplication** . . 349
Notes from the Branches 365
New Equipment 369
Book Reviews and New Catalogues . 370

Commercial :

British and World Shipbuilding . . 366
New Patents 371
Company News 372
Raw Material Markets 376
Current Prices of Iron, Steel and Non-ferrous Metals (Advert section) . . 44

AN INDUSTRIAL NEWSPAPERS PUBLICATION

Published Weekly

Single copy 9d.; by post 11d.;
Annual subscription: home 40s., abroad 45s. (prepaid).

17/19 JOHN ADAM STREET, ADELPHI, LONDON, W.C.2

'Phone: TRAfalgar 6171 (10 lines)
'Grams: Zacateccs, Rand, London.

Addition not Multiplication

We make no claim to be experts in the art of economics. (The word "art" is used as the conclusions reached by the various experts are so divergent as to preclude any true scientific basis for the subject.) Thus, personal experience is the sole reason for putting forward the following views. Between the two wars there was a reduction in income tax. The first year, the benefit was minimal, but later, as manufacturers and others found themselves receiving their raw materials at slightly lower prices, the overall gain to the ultimate user was certainly a worthwhile one. It is to be noticed that the Council of Ironfoundry Associations and similar bodies which represent very important buyers of fuel are loud in their protests at the constantly increasing price of this raw material, but also are sceptical of any change in the foreseeable future. We recently published a letter from the Foundry Trades' Equipment & Supplies Association, which was an open reply to a Government request for the stabilization of existing prices. The letter rightly pointed out that this was beyond their control as selling prices depended very largely on the costs associated with, and the prices of, many raw materials which were controlled by the nationalized industries. Here, then, is the crux of the problem, every time the price of fuel increases, the manufacturer knows that this is not a single charge, but a "snowball" as he will have to pay extra money not only for fuel but for everything he buys which has necessitated processing. He therefore must add to his prices not only the amount due to the increased cost of fuel, but a respectable margin to cover the—as yet unknown—increments to which he will be subjected. Herein is a fundamental aspect of inflation. By and large, the manufacturer does not suffer too much until it gets out of hand and reflects on his ability to export, for it is axiomatic that we, in this country, only exist through exports.

Thus, our remedy—though it is one which inherently we dislike—is to use the huge budget surplus to stabilize the cost of coal. If this were done, only one fixed payment would be made, whereas when the losses on coal-mining are made good by increases in the selling price of coal, the total amount to be paid is this increased price plus augmentation by every concern which uses coal in the supply of any services. The stabilization of the price of coal would help in some measure in arresting the ever-increasing cost of manufacturing.

However, there may be a flaw in this amateur economics for it is realized that "fools rush in where angels fear to tread".

G

Correspondence

GRAIN SHAPE OF FOUNDRY SANDS

To the Editor of the FOUNDRY TRADE JOURNAL

SIR,—In these days of widespread foundry sands control it is surprising that there are still two schools of thought on the effect of the shape of the sand grains on mould strength.

Quite a few authorities, including very recent papers and text-books on foundry practice, infer that angular grains promote greater mechanical strength than do rounded grains in moulding sands. The work of Rees and Davies* appears to disprove this supposition, and I have yet to see any results published to support the idea that an increase in mechanical strength is given by angular grains in sands of similar grading and chemical composition bonded with the same amount of clay. In my own experience of silica sands, rounded sands always yield higher strengths than do angular sands of similar grading in both core and mould mixes when tested on the usual sand-testing apparatus at room temperature. These results, of course, only give the strength of the material before casting and do not take into account the effect of grain shape, if any, upon subsequent expansion, cracking or scabbing that might occur.—Yours, etc.,

F. LESERVE,
Foundry Laboratory.

British Industrial Sand, Limited,
Redhill, Surrey.

* *Proc.* IBF, 42 (1949), A175.

Canadian Market for Protective Equipment

Industrial protective clothing is the subject of a market report prepared by the United Kingdom Trade Commissioner Service in Canada and circulated by the Export Services Branch of the Board of Trade.

The report covers safety footwear, gloves, asbestos clothing, headgear, goggles, respirators, and other clothing of a special protective character. Canada is expanding industrially. Safety clothing and equipment are intensively promoted and their use is increasing. The market is shared almost entirely between domestic Canadian and American manufacturers. The products are sold either direct to industry by the manufacturer or through specialist supply houses, among whom three or four firms predominate.

Opportunities exist for the sale of United Kingdom safety footwear, gloves, headgear, and PVC clothing. There is a lucrative market for eyewear and respiratory equipment and, in view of the sales potential, a closer examination by British firms is recommended.

Basic Materials Prices Fall

The index of prices of basic materials other than fuel used in British industry fell by 0.6 per cent. during April to 154.7. This compared with 149.4 per cent. in April last year. The indices for materials used in the mechanical engineering and electrical machinery trades, according to the latest issue of the "Board of Trade Journal," fell by 0.8 per cent. and 2.4 per cent. respectively. Items made from brass and copper, the price of which came down by 7.8 per cent., carry an especially heavy weight in the electrical machinery index. Among other commodities which declined in price were tin ingots (down 5 per cent.), lead (down 4.5 per cent.), and zinc (down 3.3 per cent.). Commodities which went up in price included aluminium ingots (up 5.6 per cent.).

Vitreous Enamellers' Summer School

This year the Institute of Vitreous Enamellers' "Summer School in Vitreous Enamelling" is being held from mid-day on Friday, June 1, until Sunday morning, June 3, at Ashorne Hill, Leamington Spa. Applications are invited for the few remaining places in the school, and those who wish to attend are requested to complete a reply form which is obtainable from the secretary of the Institute, Mr. J. D. Gardom, John Gardom & Company, Ripley, Derbyshire.

The programme for the first day includes a works visit to Cannon Industries, Limited, Tipton, in the afternoon, to be followed by a discussion on the visit in the evening. Saturday, June 2, will be mainly devoted to technical sessions, and papers to be presented include: "Shot-blasting of Cast Iron for Vitreous Enamelling," by T. O. Wilkes; "Furnaces—Types, Operation, and Maintenance," by J. A. Swain; "Dry-process Enamelling," by J. Fyfe; "Preparation of Sheet Iron for Subsequent Vitreous Enamelling," by H. Symonds; "Suspension of Wet Ground Enamels," by Dr. German or Dr. Ratcliffe; and "Pyrometers—Their Construction and Care," by L. Neall. Finally, there is to be an address by the chairman. After breakfast on Sunday morning the delegates disperse.

IBF New Sections

At the Council meeting of the Institute of British Foundrymen, held recently in York, two new sections of the Institute received official recognition. These are the Northampton and District section of the East Midlands branch—which has been holding well-attended meetings in the area for some time under the title of the Northampton Group—and the Stoke-on-Trent section of the Lancashire branch—where a number of preliminary and most encouraging meetings have been held earlier this session. In both these areas, no doubt, there will be an influx of applicants for membership now that full local meetings can be organized. Such applications in the Northampton area should be addressed to the section secretary: Mr. W. D. Ford, c/o Morris Motors, Limited, Wellingborough, and in the North Staffordshire area to the acting secretary: Mr. J. Bailey, of Cooke, Bailey, Limited, Morley Street, Hanley, Stoke-on-Trent (tel. Stoke-on-Trent 22627). Existing members in the respective areas can no doubt assist in bringing the new arrangements to the notice of those qualified to join the Institute.

Plans for Duke's Study Conference

Publication of the final programme for the Duke of Edinburgh's study conference on "Human Problems of Industrial Communities within the Commonwealth and Empire" has been announced. The conference, which some 300 people will attend, will open at Oxford on July 9, when the Duke of Edinburgh will deliver a presidential address. The conference will close on July 27.

One of the principal speakers at the conference will be Sir John Maud, Permanent Secretary to the Ministry of Fuel and Power. Among the other principal speakers will be Lord Citrine, chairman of the Central Electricity Authority, Sir Harry Pilkington, a former president of the Federation of British Industries, and Sir Harold Hartley, who is chairman of the conference Council. The chairmen for the various sessions include the Duke of Edinburgh.

Experience with Fast-drying Bonding Materials

By A. I. Donaldson

MR. A. I. DONALDSON is chief metallurgist at the Argus Foundry Limited, Thornliebank. He served an apprenticeship with Carron Company, Falkirk, and following this, worked in the metallurgical department at Woolwich Arsenal. After two years he returned to Carron as chief chemist and metallurgist. Later, he went to the Davy and United Engineering Company, Limited, Sheffield, as metallurgist, subsequently being appointed foundry superintendent. He left there in 1950 to take up his present appointment.

Initially, the Author relates the results from a number of experiments using rapid-drying oil-sand mixtures as a basis for cores. This material proved to have limited practical application, however, and attention was turned to the CO_2 Process. After outlining the methods of sand drying, cooling and elevation, the first trials in coremaking and moulding are described in detail, step by step, followed by more ambitious projects on the moulding side. Such matters as sand storage and re-use, mould coatings and sand temperatures are dealt with in their practical applications. For large cores, and in respect of costs for moulds, a not very attractive picture is painted for the Process. However, it is made clear that factors other than basic costs of raw materials and processing can influence a final choice in favour of the adoption of the CO_2 Process for certain work. Notes are included on the chemical reactions involved in the CO_2 Process; on patterns, and pattern coatings. The making of several jobs by the Process, as running lines, is described and several of these castings are illustrated.

Fast-drying Oils

The Author has carried out some experimental work on the self-hardening, fast-drying oils and, at first, was very impressed with the potentialities, particularly with the speed with which a core could actually be made. It soon became apparent, however, that there were snags in the process which would offset any benefits which could be derived. The process is generally as follows: dry silica sand is mixed with an oil and an accelerator powder to form a mixture similar to a very dry oil-sand mixture. It is then placed in the corebox and can be quickly rammed into the required hardness as it has no green bond. The box is allowed to stand until the mixture has set, the time for setting being controlled by the ratio of accelerator powder to oil in the original mixture. Care has to be taken with the choice of proper temperature of the dry sand; other factors, such as humidity of the atmosphere, seem to have an effect on the setting time. When the core has set, it is drawn from the box and baked for only about half the time required for an ordinary oil-sand core. It is then ready for use in a mould.

When the cores were being made experimentally, it was possible to produce very good cores, as the knock-out properties were excellent. However, when an attempt was made to apply the system on a production basis, difficulties arose which the Author's company were not able to overcome, the chief of these being due to the lengthy setting time. If a fair setting time, say of 45 min., was allowed, there was insufficient floor space to permit the coremaker to continue working. An effort was made to overcome this by speeding up the setting time, but this tended to cause friability in the core. Furthermore, many of the cores in the Author's foundry are made on machines and this method is unsuitable for such work.

It was also found that the slightest imperfection in the corebox prevented a good draw and that a fairly-generous taper was required before the process would work satisfactorily. On the whole, the problem of supplying suitable mixtures to give reasonable bench "life" for some jobs and quick-setting properties for others, appeared too difficult of solution and the Author's company has not pursued this matter any further for the time being. It is obvious, however, that where a corebox and core can be allowed to stand without interfering with other work in progress, excellent cores can be made by this method, with superlative knock-out properties. Cores such as water-jackets and cylinder port-cores could be made with this material with good results.

CARBON-DIOXIDE PROCESS

Briefly, the CO_2 Process is a method of making moulds and cores from a special sand mixture using silica sand with the addition of sodium silicate, together with, in some circumstances, small percentages of pelleted pitch, coal-dust, or other agents which will burn out.

* Paper read before the Scottish branch of the Institute of British Foundrymen.

FIG. 1.—*Gas-fired rotary drier fed by an underfeed belt from the hopper on the left.*

FIG. 2.—*Arrangement of the plant for storing dry sand for coremaking.*

Chemical Reaction

Much has been published about the CO_2 Process but it might be helpful to run through the chemical reaction involved. The Process is based on the reaction between sodium-silicate solution and carbon-dioxide gas and is expressed by the equation:

$Na_2 Si O_3 + H_2O + CO_2 = Na_2 CO_3 + Si O_2 + H_2O$.

There is a critical ratio of $Na_2 O : Si O_2$ in the silicate for the precipitation of silica and this change is brought about by the carbon dioxide which changes the $Na_2 O$ to $Na_2 CO_3$. The silica is precipitated in the form of a gel which immediately starts to set. Thus, all the sand grains in a rammed mould which are coated with the silicate set together into a hard mass when the carbon dioxide is passed through it.

Sand Preparation

The Process requires a dry, cold, silica sand as it is essential that the water in the binder is not dried out. A washed Irvine sand was used at the Author's foundry for the process. This is dried in the apparatus shown in Fig. 1, which consists of a gas-fired rotary drier fed by an underfeed belt from a hopper which can be seen on the left of the illustration. The main storage facilities for sand are to the rear of this hopper and consist of two brick-built hoppers with draining bottoms. Each hopper is emptied in turn to allow the sand to drain away as quickly as possible. The sand drier is capable of handling two tons of sand per hour, the sand passing down inside the inclined cylinder of the drier whilst the hot gases pass upwards from the burner end and down the outside to the stack. The exit temperature of the sand is about 180 deg. F. The drier was installed to provide sand for coremaking and Fig. 2 shows the arrangement of the plant for storing dry sand for this purpose. A bucket elevator takes the sand from the drier and carries it up to the top of the hopper and from there it falls down a cascade on to a thrower. The hopper is divided at its centre line and by altering the direction of rotation of the thrower, the hot sand can be directed into either one half or the other of the hopper. By this means sand can be allowed to cool in one half while that in the other half of the hopper is in use.

Not a great deal of cooling takes place in the hopper, however, and the sand was often found to be quite warm and unsuitable for the CO_2 Process. It was necessary also to elevate the sand into a hopper from which it could feed into a skip-hoist serving a mill. There was not very much space available to instal an elevator and it was proposed that the dry sand might be blown into the CO_2 sand hopper. A hole was therefore cut in the side of the existing hopper and the sand bled off into the path of a fan which blew the dry sand up and into the hopper. This arrangement is shown in Fig. 3, but when the picture was taken the impeller had been removed for repair. This arrangement has been working satisfactorily at the Author's firm for several months and due to the current of cold air from the fan, the sand is delivered to the hopper quite cold and ready for use.

Initial Experiments

Originally, the objective was to make cores by following out the instructions laid down by the makers of the patented CO_2 binder. Initially, a dry silica sand was used with 4 per cent. of binder and 2 per cent. of pelleted pitch. From this mixture, both large and small cores were made. They were fairly good with a reasonable hardness and gave a good finish when used in a casting but they did not give satisfactory knock-out properties. The smaller cores were reasonably easy to get out but the larger

ones—of the order of 10-in. dia.—seemed to set very hard during casting and resisted knock-out. This seriously interfered with the progress of the work in the dressing shop and this work was not carried much further.

On the moulding side, however, a situation had developed in which it seemed the CO_2 Process could play a real part. An order for diesel-engine crank-case castings was received. These would originally have been made in green-sand moulds, but it was not possible to make them to the required dimensional tolerance by this method. As the firm's drying stoves were already overloaded and could not take any more work, the management was thus faced with the problem of finding an alternative method of making the moulds and the CO_2 Process seemed to offer a solution. A sand mixture of the following type was employed:—dry Irvine sand 94 per cent., sodium silicate 4 per cent. and pelleted pitch 2 per cent. The dry ingredients were mixed in a Rotoil mixer for one minute, the silicate was then added and the whole mixed for a further two minutes.

Using this sand, the crank-case mould was rammed up on a plain jolt machine and the CO_2 gas was applied through holes bored in the sand. The mould afterwards appeared quite hard but on withdrawing the pattern, part of the face of the mould was found to adhere to the pattern. This was thought to be due to insufficient gassing and the work was repeated and the gassing time doubled. Again, on drawing, it was found that parts of the mould were sticking to the pattern face and that a deposit of sand was covering the whole of it. The management persevered with the same mixture trying to draw the pattern from the hardened mould, but it soon became obvious that they would be unable to strip a reasonably good mould by this method. An attempt was then made to draw the pattern from the sand in the "green" state but the mould immediately collapsed. It was then decided to neglect the stipulations laid down by the firm supplying the binder as to absence of clay in the sand, as it was considered that if the pattern could be withdrawn from the mould when it was in the green state, then it could be gassed through the mould face, with satisfactory results. Experiments were therefore carried out using varying quantities of bentonite and water additions to the sand and it was found that a minimum of 5 lb. per sq. in. of green strength was necessary to give a good draw. The sand mixture used was then 89 per cent. Irvine sea sand, 3 per cent. Western bentonite, 1½ per cent. pelleted pitch, 1½ per cent. water, 4 per cent. sodium silicate and 1 per cent. molasses, giving a green bond of 5.5 lb. per sq. in. and a permeability of about 150. It was found that the bond was not being properly developed in the earlier mill and the sand was then prepared in an August's mill. These changes immediately gave good working results and this method has been used as a basis for all CO_2 moulding ever since. The mixture has since been modified by the introduction of 10 per cent. Mansfield sand to reduce the permeability a little, but no other steps have been taken to improve the mixture.

Patterns

In the early stages of the work, it was found that ordinary pattern varnish did not stand up to the attack of the sand, probably due to the alkalinity of the sodium silicate. Several materials were tried and two were found which answered very well, *viz.*: (1) a plastic emulsion paint to which about

FIG. 3.—*Sand from the hopper being elevated and cooled by air blast.*

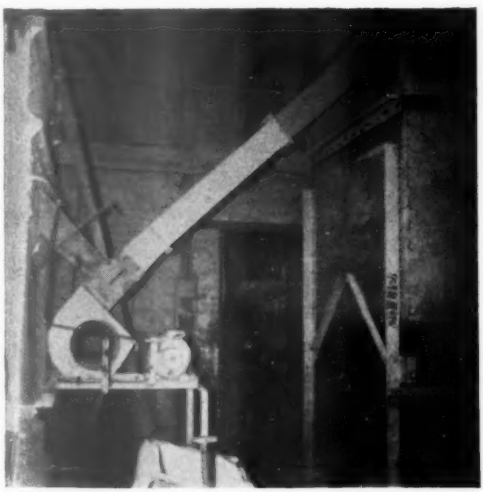


FIG. 4.—*Patternplate in position on the jolt machine. The plate is covered with a layer of CO_2 sand which is jolt rammed around the pattern to a depth of 2½ to 3 in.*

4 per cent. of plumbago was added. When the paint was dry, a very high polish could be imparted to the pattern and this seemed to be quite resistant to attack, but though successful, a fair amount of labour was involved in applying this preparation satisfactorily; (2) a clear, cellulose paint which was evenly applied by a brush or spray over the ordinary pattern varnish. This had the advantage of leaving the pattern markings clear and is now in use on all patterns to be used for the CO_2 Process in the Author's foundry.

Mould Making

A patternplate for a diesel crankcase in position on the jolt machine is shown in Fig. 4. It is covered with a layer of CO_2 sand which is jolt rammed around the pattern to a depth of 2½ to 3 in. This is backed up with ordinary moulding sand and the mould is then rammed as hard as possible. The pattern is now drawn and the mould can be finished in the usual way, as seen in Fig. 5. The mould is next treated with CO_2 as shown in Fig. 6; the tube leading from the ring main can also be seen in this illustration. This tube is fitted with a valve contained in the male portion of a bayonet cap. The female part is contained in the board and on insertion, the gas is automatically turned on and on removal, it is turned off, thus ensuring no wastage.

Fig. 7 shows a selection of the boards in use to suit moulding boxes of different sizes. They are made from plywood, the valves being screwed into inset plates. The underside edges of the boards have lengths of sponge rubber attached to them to form a seal round the joint of the box and at the same time, hold it clear of the sand surface thus allowing the gas to permeate through the joint face, and give a good hard surface overall. Optimum gassing times are found rather difficult to predict as each job has to be judged on its merits and it is largely a matter of trial and error.

There was some concern at the Author's company at first about the dangers of over-gassing but, so far, no ill effects from this cause have been noted; in the main, any trouble tends to derive from under-gassing. The pressure of the gas is another factor which reflects on gassing time. The management at the Author's works have been working on a main pressure of 45 lb. per sq. in. but the Author prefers to use a higher pressure and so reduce the time of gassing. It is considered that there must be adequate pressure of gas to ensure penetration into the mould. If gassing is not thorough and the mould cavity is deep, it may be found that only about ¼-in. of sand has been hardened and the sand behind is wet and soft. This can have two effects; if it is in the top part of the mould, the section will probably drop out on turning over and no great harm is done. If, however, it is the bottom part, the casting may "swell" and a great deal of gas evolution may take place, giving blowhole trouble in the casting.

Mould Coating

Having gassed the mould, it is next necessary to apply a coating of blacking to it. Since the mould is not to be dried, some medium other than water must be used for applying the blacking and a mixture of isopropyl alcohol, plumbago, blacking and resin is used in the following proportions: 1 gall. isopropyl alcohol, 1½ lb. blacking, 2 lb. plumbago and ½ lb. urea-formaldehyde resin. This mixture needs to be constantly stirred and it is necessary to

FIG. 5.—*Finishing a mould in the usual way after removal of the pattern.*

FIG. 6.—*Gassing the mould with CO_2. The gas is obtained from a ring main.*

FIG. 7.—*Selection of plywood gassing boards for use with boxes of different sizes. The valves are screwed into the plates, and sponge-rubber edges provide for sealing.*

FIG. 8.—*Ignition of the blacking mixture brushed on the mould surfaces.*

issue it to the moulders in small containers to ensure that it is kept properly in suspension. It may be applied by brush or spray to the mould face and then immediately ignited. The alcohol burns away and the heat cures the resin, forming a hard face with the blacking and plumbago. Figs. 8 to 11 show respectively a mould in process of ignition, moulds cored-up ready for closing, two mould top-parts ready finished and (Fig. 11) a casting from this mould, as knocked-out. It can be seen that it is free from adhering sand and has very clean lines.

Ramming Properties

CO_2 sand, even when containing a proportion of clay, is quite "flowable" and can be used with impeller rammers or jolt/squeeze moulding machines. In the Author's foundry, it has been used extensively with the impeller rammers but the layout does not readily lend itself to the introduction of the sand and the sand has had to be shovelled on to the belt by hand, a factor tending to give intermittent ramming. This method also caused the appearance of soft spots in the mould which later gave friable patches if they were not discovered and rammed hard before gassing. With this method, also, it is difficult to build up a shell of sand over a pattern and as a result, the impeller rammer tends to be a waster of CO_2 sand. The jolt machine is much more economical and gives a very good reproduction of the pattern. In the Author's opinion, an essential requirement is to get hard, even ramming of the sand all over the pattern and this allows the gassing to proceed properly and results in a good hard mould.

The quality of a pattern is also shown up in this work. Any pattern faults are quickly revealed by the Process and there is no doubt that a good quality pattern gives first-class results.

Production Jobs

Fig. 12 shows two diesel-engine crankcases which was the first job undertaken by the Author's company in CO_2 sand on a production basis. Up to date, about 250 of these castings have been made and the total scrap resulting is under 2 per cent. This is an example of a first-class pattern giving excellent results with the Process. However it should not be thought that only new pattern equipment can be used, as the Author is employing for the Process, patterns which have been in use in his foundry for years. Moulds from these patterns require more finishing and often patching but this can readily be done though it does not give the same finish on a casting as a mould drawn from a good pattern and left untouched.

Sand Storage

Since the atmosphere contains a proportion of carbon dioxide, sand, containing sodium silicate, will harden if left exposed to the air. If the sand is in a closed container, only a small crust on the top will be affected and once this has been removed, the remaining sand is in good condition. Experiments have been made in relation to this matter and it has been found that good moulds can be made from sand which has been left for several days, covered only with dampened bags. Small amounts of sand left over from a day's working, are collected and added in small percentages to new mixtures.

If the sand as mixed is at all hot, it has been found that on standing it will dry off rapidly, almost to a powder. This also applies if the sand is rammed when slightly hot, as the mould face dries rapidly and cannot be gassed satisfactorily—the surface and edges are friable and rub away under pressure of the fingers. The addition of extra water at the mill can offset this, but as accurate measurement is not possible, this practice is not recommended; the only real solution is to employ cold sand for the mixtures.

FIG. 9.—*Moulds which have been cored and are ready for closing.*

Re-use of Sand

The Author's company has not made a practice of re-using the sand knocked out from the moulds. It is quite easy to pick out the CO_2 sand at the knockout and so far, they have taken the easy way out and disposed of it. This, of course, does not get rid of all the sand (only the lumpy material) and a certain amount finds its way into the sand system. The only factor in the CO_2 sand which could give trouble is the sodium-carbonate content but so far, no significant build-up in the alkalinity of the system sand has been found. The knock-out sand is processed and provides the basis for green-sand and skin-dried moulding with the impeller rammer. So far, there is no evidence of trouble due to the contamination of ordinary sand with the CO_2 sand.

When castings were cleaned by the Hydroblast system, it tended to bring the CO_2-bonded core out in lumps and these lumps absorbed some water and subsequently disintegrated. Tests showed that all the alkali comes out on standing a lump of the sand in water for about five minutes and it would therefore appear that Hydroblasting would remove the alkali and restore the sand in a perfectly usable condition.

Coremaking

Up to the present, the Author's foundry has been principally concerned with moulding and has not proceeded very far with the question of coremaking. The company's coreshop is roughly divided in three parts, *viz.* (1) the light coreshop, where the work is done on individual benches and placed on a pendulum conveyor serving a continuous drying stove; (2) the medium section, where the coremaking is done on machines and the cores are placed on a steel-band conveyor leading to a continuous stove; and (3) the heavy section, where the cores are made on the floor and turned out on plates which are placed on racks. These racks are then moved into static stoves for drying.

In section (3), the greatest potentialities are afforded for in the making of CO_2 cores, but the difficulties so far encountered have not been encouraging for the future employment of the Process. Although satisfactory cores (reasonably hard cores with good skin) have been produced with this Process, the Author feels that in no circumstances could these cores be compared in quality with good oil-sand cores. When cores made with the CO_2 Process have been left standing, it was found that they were friable at the edges and, when two halves were joined together, a large gap was left to be filled with some sealing compound. Further, when the surfaces to be jointed were rubbed to bring them to size, the surface under the skin was found to be friable and tended to "keep running," thus making the application of the jointing compounds very difficult and it was sometimes found subsequently that cores tended to split along the joints. It has been found essential to black the cores before jointing as, if this is not done, the alcohol seeps in at the joints and, on ignition, vaporizes and forces the two halves apart. It has not been possible to get a higher strength than about 350 lb. per sq. in. after gassing, whereas the staff of the Author's company are used to oil-sand cores of about 900 lb. per sq. in. dry-strength. This would mean that there would be a fair amount of broken cores in handling in the shop.

Knock-out Problems

The last problem on the coremaking side has been that of knock-out and it is by far the most serious. At the de-coring point in the coreshop, the cores are knocked out by three men, the castings being slung in the crane and the cores removed by hitting the castings with a hammer. With oil-sand, the cores usually run out, sometimes requiring a

FIG. 10.—*Two finished top-part moulds.*

little persuasion with a bar if the core is of an awkward shape. Thus it can readily be seen that any lengthening of the knock-out process will cause a serious hold-up in the dressing shop. Various mixtures of sand have been tried to give the best knock-out properties possible and various percentages of coal-dust, plumbago, and pitch, in addition to some patented easy-knock-out binders have been added. These have met with various degrees of success properties, but the best CO_2 core has taken three times as long to knock-out as the same job made in oil-sand. The trouble seems to arise mainly in cores of the larger diameters. On casting, the outer layer is burned and quite friable, and the centre is reasonably soft and apparently unaffected by the heat. Between these two, however, is a layer which sets like concrete, and this is the part which prevents the core from "running" out. It would appear that there is a critical temperature range for the core mixture within which a very hard substance is formed, although the cores strip very well and do not fuse on to the casting. Under the present conditions, therefore, it is not thought that a core binder which measures up to oil-sand has been found and, since the foundry is not pressed for drying space, it is continuing to use oil-sand and only to experiment with CO_2 sand for cores.

Costs

Many statements have been made about costs of using the CO_2 Process and it should be pointed out that no final appraisal of costs can be made unless the foundry in question has been working the Process for a long time. However, some comparisons can be made of the bare costs of the materials for dry-sand, oil-sand and CO_2-sand work. When working wholly on dry-sand, 25 tons of new silica sand, 2 tons of bentonite and 2 tons of pelleted pitch per week were added to the sand and the costs of these items were:—

	£	s.	d.
25 tons Sand at 24s. 6d. per ton	30	12	6
2 tons Pelleted pitch at £23 ton	46	0	0
2 tons Bentonite at £30 ton	60	0	0
	136	12	6
Cost of coke for drying (10 tons at £9 ton)	90	0	0
Total cost of materials	226	12	6
Wages of stove attendant	10	0	0
Total cost for dry-sand moulds	£236	12	6

The weight of castings produced was 30 tons and hence the cost per cwt. was $\frac{£236\ 12s.\ 6d.}{30 \times 20} = 7s.\ 10d.$

In similar manner, the cost of 100 tons of CO_2 sand was:—

	£	s.	d.
100 tons Sand at 26s. 6d. per ton	132	10	0
4 tons Silicate at £16 2s. 6d. ton	64	10	0
1½ tons Pelleted pitch at £23 ton	34	10	0
1 ton Molasses at £16 10s. ton	16	10	0
3 tons Bentonite at £30 ton	90	0	0
	338	0	0
Consumption of carbon dioxide 22 lb. per ton of sand), 2,200 lb. at 4¾d. per lb.	42	7	11
Total cost of materials	£380	7	11

Here the weight of castings produced was 33 tons, and the cost per cwt. $\frac{£380\ 7s.\ 11d.}{33 \times 20} = 11s.\ 6d.$

Thus, the cost of moulding by the CO_2 Process was 3s. 8d. per cwt. above that of dry-sand moulding.

The weekly consumption in the foundry of oil-

FIG. 11.—*Casting as knocked-out from the mould previously illustrated. It is free from adhering sand and shows very clean lines.*

FIG. 12.—*Two diesel-engine crankcases, the first job undertaken in CO_2 sand at the Author's foundry.*

FIG. 13.—*Board in position over a mould, ready for gassing. In the centre of the board is the bayonet cap ready for insertion of the valve.*

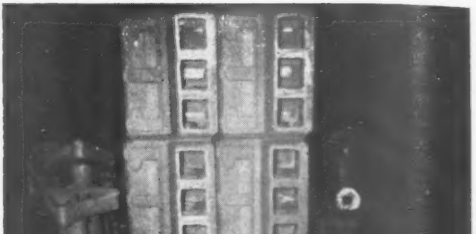


FIG. 14.—*Diesel-engine crankcases and other castings in the dressing shop ready for despatch.*

bonded sand is about 60 tons and the cost as follows:—

	£	s.	d.
60 tons Sand at 26s. 6d. ton	79	10	0
¾ ton Linseed oil at £155 10s. ton	116	12	6
15 cwt. Core powder at £65 ton	48	15	0
	244	17	6
Cost of coke—10 tons at £9 ton	90	0	0
Stove man's wages	10	0	0
Total cost	£344	17	6

For an output of castings per week of 90 tons, the cost per cwt. is $\frac{\text{£344 17s. 6d.}}{90 \times 20}$ = 3s. 10d. To produce the same amount of CO_2 sand, the cost would be:—

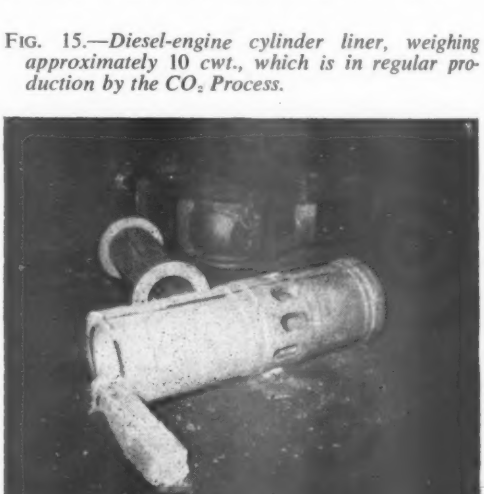
	£	s.	d.
60 tons Sand at 26s. 6d. per ton	79	10	0
1·8 tons Sodium silicate at £16 2s. 6d. ton	29	0	0
0·6 ton Molasses at £16 10s. ton	9	18	0
0·9 ton Pelleted pitch at £23 ton	20	14	0
	139	2	0
Carbon dioxide (1,320 lb. at 4¾d. lb.)	25	8	9
	£164	10	9

For a weekly output of castings of 90 tons, the cost per cwt. would be $\frac{\text{£164 10s. 9d.}}{90 \times 20}$ = 1s. 10d.

In this case the saving in cost, therefore, would be in the region of 2s. per cwt. of castings in favour of the CO_2 Process, but as previously stated, in the Author's opinion, the CO_2 sand cores do not measure up to oil-sand cores.

Overall, if a foundry was using CO_2 sand for moulds and cores instead of dry-sand and oil-sand, it would cost more to produce castings if material costs and drying costs alone were to be considered. The reason the Author's company still carries on using the CO_2 Process is that there used to be a very serious "bottleneck" in the firm's drying capacity, but now that the CO_2 Process has been adopted this bottleneck has disappeared and there is now stove capacity to spare. As the patterns are put in good order, there is reason to believe that no mould drying will be done in the Author's foundry. The firm has satisfied itself that the Process can be reasonably worked and they can tackle most of the dry-sand with a fair prospect of success, and therefore, in the new foundries which the company is building, some of the stoves have been cut out. However, no way of making a successful loam core from this material has yet been found and the making of heavier castings in CO_2 sand presents problems which may take some time to solve.

FIG. 15.—*Diesel-engine cylinder liner, weighing approximately 10 cwt., which is in regular production by the CO_2 Process.*



Figs. 13 to 16 show some of the methods and work which has been undertaken by the Process. Fig. 13 shows a board in position over a mould prepared for gassing. The bayonet cap can be seen in the centre of the board ready for the insertion of the valve. A pile of diesel-engine crankcases are shown in Fig. 14 in the dressing shop ready for despatch—the production of these and other designs of crankcases has been the most successful job with CO_2 moulds, the scrap being as low as 2 per cent. Fig. 15 shows a diesel-engine cylinder-liner weighing about 10 cwt. which is in regular production in the Author's foundry and made by the CO_2 Process. This particular job demonstrates one of the items which make for a saving in cost and which cannot be put down in figures. When produced from dry-sand moulds, the circumstances require that nine moulding boxes shall be in circulation to give an output of three castings daily. With the CO_2 Process, the same three boxes are used daily, liberating six for other work. Fig. 16 illustrates a selection of gunmetal castings made by the Process; the remarkable feature about gunmetal being that it does not penetrate the CO_2-bonded sand in spite of its high permeability.

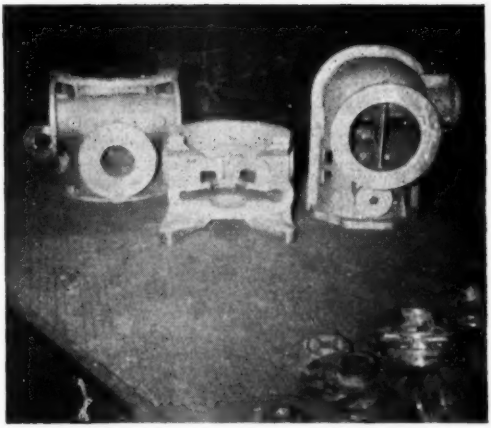


FIG. 16.—*Selection of gunmetal castings made by the CO_2 Process in the Author's foundry.*

Acknowledgments

The Author wishes to acknowledge his thanks to the team at Argus Foundry who carried out the work, to his colleagues for their efforts in making this Paper possible and thanks also the directors of the firm for permission to publish it.

Publications Received

Bulletin and Foundry Abstracts, March, 1956. Published by the British Cast Iron Research Association, Alvechurch, Birmingham.

This issue is of extra value inasmuch as it contains an up-to-date bibliography of the Carbon-dioxide Process. With this issue came an index of all material reviewed between July, 1953, and May, 1955. This latter is the type of booklet which, if kept handy, will provide the key to answering many questions as to what information is available on any given ironfoundry subject. The indexing has been meticulously carried out. Such a system of "boiling down" information and presenting it in an accessible form is an ideal method, as it gives as near a complete coverage for the period as is humanly possible.

Flow Production and Automation—Eighteen Axioms, by Frank G. Woollard. Published by the Industrial Administration Group, c/o College of Technology, Gosta Green, Birmingham, 4.

Whilst it is desirable that the foundry executive should have an appreciation of flow production and automation means, it is quite unnecessary for him to be an expert on the subject. This little book is ideal for inculcating a knowledge of what has happened and the trends of the great engineering works for which the foundry caters. There are many references to the important part which castings play in the production of engineering components, and one paragraph which Mr. Woollard includes is certainly worth quoting, as it is of great significance to many foundries. It reads:

"It is desirable that in this country we should use more machinery and also machinery with greater capacity, more handling plant, more ancillary machines and more portable tools. The use of over-size machines rather than those which are only just big enough or powerful enough for the job is a great advantage. This is exemplified by the following extract from a letter received from a correspondent in the USA, who writes: 'In our foundry considerable time was spent in chipping gates and cleaning the banks on cylinder blocks before machining. With a new mill these operations are no longer required because the machine is built sturdy to remove this excess stock.' There is evidence that this idea of greater power for machine tools is growing in this country."

The book is unreservedly recommended to readers as the cheapest means possible of learning just what automation means.

V. C. F.

City and Guilds Broadsheet, No. 1; issued by the City and Guilds of London Institute, Gresham College, Basinghall Street, London, E.C.2.

This is the first issue of a new publication to appear six times a year. Naturally this one is full of interest, as it can give such information as that in 1955, over 100,000 candidates entered for the City and Guilds of London examinations. Then in its nine paragraphs it covers such diverce subjects as fuel economy, foremanship in the building industry, electrical technicians, technical illustrations, the Insignia Award, the Associated Examining Board, its Art School, and crafts competition at the last building exhibition. This broadsheet is available to readers on writing to Gresham College.

THE TREASURY has made the Import Duties (Exemptions) (No. 5) Order (SI No. 684), which continues for a further period of one year from May 13 the exemption from duty under the Import Duties Act, 1932, of certain forms of nickel and ferro-nickel alloys imported in the forms described in the schedule to the No. 3 Order (SI No. 676).

National Industrial Safety Conference

The strength of the voluntary movement for the prevention of accidents in industry was emphasized at the week-end May 11 to 13 when over 600 delegates, representing firms and organizations all over the British Isles, and including many visitors from overseas, gathered at Scarborough for the annual National Industrial Safety Conference organized by the Royal Society for the Prevention of Accidents. The programme included papers on various aspects of industrial accident prevention, and a popular feature was once again the trade exhibition, where on over 50 stands delegates were able to examine at their leisure such items of safety equipment as machine guards, safety footwear, goggles, protective clothing, barrier creams, etc.

On the Friday evening a civic welcome was given by the Mayor of Scarborough, after which the president, Sir Howard Roberts, C.B.E., D.L., J.P., gave his Address. The conference was then formally opened by the Rt. Hon. Iain Macleod, M.P., Minister of Labour and National Service. An interesting ceremony which followed was the presentation of the Sir George Earle trophy and a Commemorative Plaque to the 1956 winners—H.M. Inspectors of Factories. It was presented to Sir George Barnett, H.M. Chief Inspector of Factories, who accepted it on behalf of his staff. The value of the papers, presented at the conference (which included "The Foundry Atmosphere" by W. B. Lawrie, M.B.E., M.SC.), was enhanced by lively discussion. Written questions from delegates were answered by a panel of lecturers.

Automation Courses

A panel of industrialists and experts on automation will preside over a six-session evening conference on automation, sponsored by the College of Production Technology, at the Eccleston Hotel, Eccleston Square, London, S.W.1. It will be opened by the Rt. Hon. Lord Sempill, chairman of the Governors of the College, and presided over by Dr. D. Woodley, D.SC., the principal. Beginning on Monday, June 4, each session will be from 6.30 p.m. to 8.30 p.m. The syllabus will cover such questions as: "The History and Survey of Automation," "A Demonstration of Control Actions Used in Automatic Process Control," "Automatic Linking and Transfer Devices," and "Conscious Machines and Process Control in the Factory." A special session is devoted to "Automation in the Office," and "A Case Study and Economic Aspects of Automatic Control." The course will end with an open forum and debate. One of the speakers is Mr. R. S. Medlock, B.SC., A.R.I.C., A.M.I.MECH.E., A.M.I.E.E., of George Kent, Limited. Further information may be obtained from the administrative offices of the College, 2, Balfour Place, London, W.1.

Demonstrations on the Spot

Just over two years ago, Atlas Copco (Great Britain), Limited, introduced a demonstration van for its range of engineers' tools. This met with considerable success and it was decided to extend the service by introducing a larger van, carrying a full range of pneumatic tools. One of the features is an Atlas Copco compressor, type KE 6, which is driven by way of belts from the power take-off on the chassis. This enables on-the-spot demonstrations to take place without relying on an outside source of compressed air, and has the added advantage of allowing customers to try tools themselves, without taking them into the factory.

New Diploma Award in Technology

Details of the award to be given by the recently created National Council for Technological Awards, under the chairmanship of Lord Hives, were announced on May 14. The Council is to grant a diploma in Technology, the courses for which will be equivalent in standard to honours degree courses of a British university. There will be two honours classes, first and second, the intention being that a student who successfully completes the course will normally reach the level of second-class honours. Those who do not reach this standard may be considered for award of the diploma at pass level. The courses which will be recognized may be either full-time or "sandwich."

The minimum time required for academic studies in a technical college must not be less than three years full time or four years sandwich. Students attending full-time courses will be expected to have suitable industrial training amounting in aggregate to not less than one year in industry. This must be undertaken either before the course, or during it, or both. The arrangements must be such as to enable the practical and academic training to be integrated. The sandwich course should include organized studies during the period of practical training in industry. The minimum age of admission to courses will normally be 18.

Since the courses are intended for those aiming at becoming professional technologists, states the Council, they should include a thorough education in the fundamentals of science and technology and their application to development and design. To help fit the students for future responsibilities the courses must include liberal studies and some instruction in the principles of industrial organization.

Castings Design

In recent years there has been a steadily growing interest among ironfounders in the subject of co-operation between founder and customer in the design of castings. The matter is one of great importance. Production costs can be reduced by close attention to this factor at all stages in the designing and casting process; the effect of such "pre-natal" care is to yield a casting made to finer limits, with a subsequent saving of time and money in the machine shop. In the late summer or early autumn the Council of Ironfoundry Associations expects to issue a publication aimed at helping both foundries and buyers of castings to achieve greater economy and efficiency in the design of castings in iron. The work will be fully illustrated and strongly bound to withstand constant use.

Iron and Steel Institute Meetings

Following an invitation from the *Centre National de Recherches Métallurgiques*, Section de Liége, the Iron and Steel Institute is to hold its special meeting in 1958 in Belgium and Luxembourg from June 17 to 28, it was announced at the annual general meeting of the Institute last Wednesday. Next year's annual meeting has been arranged for May 22 and 23, and the special meeting next year will take place in Sheffield in the week beginning July 8. At last Wednesday's meeting the retiring president of the Institute, Sir Charles Bruce-Gardner, induced the president-elect, Dr. H. H. Burton.

Testing the Gas-content of Molten Metals in a Foundry

*By B. R. Deoras, B.Sc., M.Sc., and V. Kondic, B.Sc., Ph.D.**

The article refers to previous work and reports experiments to check whether the basic empirical assumptions of the density-type gas-test for aluminium and some of its alloys are quantitatively valid and also if density-type tests can be correlated to true gas-content as revealed by gas extraction methods. The effect of pre-heating the density-test mould was also examined. The results appear to justify the application of the density-test under actual foundry conditions and also its use as a check on other—and more accurate—methods which may be developed. In conclusion, there is comment on the qualitative reduced-pressure test for gas in aluminium alloys.

Introduction

A large number of either qualitative or partly quantitative tests have been suggested in the past for rapid evaluating the gas-content of molten metals on the foundry floor. Qualitative tests depend essentially on visual observation and comparison (fracture, porosity, sinking, etc.) whilst certain measurements are carried out in the more quantitative tests (density, radiography). A general criticism can be made against all these tests that they do not show the true or factual gas-content of the metal, as in all methods of sampling suggested, some of the gas either escapes from the sample or is retained in it as a solid solution, and its effect is concealed. Owing to this, a correction factor has to be used, in order to convert the measured quantities into the true gas-content. This correction factor is determined experimentally.

One of the gas-determination tests that is sometimes used in foundries is that suggested by Ohira and Kondic[1]. This test is semi-quantitative and depends on the evaluation of density of a slowly-cooled and fully-fed sample. It appeared desirable since the publication of the previous work concerning this test to carry out additional experiments: first, to check, using absolute methods of gas determination, whether the basic empirical assumptions of this test are quantitatively valid, and secondly to attempt to establish a relationship that would make it possible to obtain the true gas-content from the density measurements, and thus to make the test fully quantitative.

Experimental Procedure

A 10-lb. charge of commercially pure aluminium containing Fe 0.8 per cent. and Si 0.4 per cent. was melted in a gas-fired furnace. Three different Al/Si alloys, Table I, were made by adding Al/50 per cent. Si master alloy. The concentration of hydrogen in the melt was varied by first gassing it with steam at 780 deg. C. and subsequently degassing it with a current of nitrogen at a rate of 1 litre per min. for one, two, four, and eight mins. At each gas concentration of the melt, "density samples" were obtained using the gas test as proposed by Ohira and Kondic[1] and shown in Fig. 1. At the same time, chill-cast samples 0.5-in. dia. and 4-in. long were poured into vertical cast-iron moulds. These samples were used for measuring the absolute gas-contents by means of a vacuum-type hot-extraction gas apparatus. The densities were measured to the third place in the decimal, by using the normal Archimedes method.

Measurement of the True Gas-content

The vacuum-extraction apparatus, Fig. 2, was designed for aluminium-alloys but was constructed in such a manner that it could be easily adapted for the estimation of larger volumes of hydrogen such as in cast iron and steel. After carefully considering the designs suggested by Ransley[2-5], Speight and Cook[3], Carney, Chipman and Grant[4], the apparatus finally designed was as follows:— The gases from the heated chill-cast specimen are extracted and collected by two mercury diffusion pumps, A and B, working in series. The extraction tube is made of fused silica and is heated in the furnace F. The analytical system is separated from the extraction system by means of a palladium tube, P_2, contained in a hard-glass tube, which could be heated to 675 deg. C. by a Nichrome-wound furnace. Thus the pressure developed in the analytical system was due to hydrogen only and was measured to 1 mm. pressure, by a sensitive McLeod gauge, M, with a range of 1×10^{-5} mm. A Pirani gauge, G, is used for continuous observations of pressure and also for leak detection. The system is evacuated to a pressure of 1×10^{-5} mm. Hg as indicated by the McLeod gauge. Pure hydrogen could be admitted for flushing the system prior to use by heating the Pd tube, P_1. A bulb, V, with a known volume was also included in the system for the purposes of calibration.

In most cases, the samples for gas determination were small cylinders machined from the chill-cast specimens and weighing 6 to 7 gm. The surface-correction factor necessary for true gas-determination, was reduced to a minimum by giving the samples a fine finish on a lathe. This factor was found to be of the order of 2×10^{-4} ml. (at 1 atmosphere) per sq. cm. of the sample area. The "blank rate" of hydrogen evolution from the apparatus itself was less than 3×10^{-4} ml., at 1 atmo-

* The Authors are research assistant and lecturer respectively in the Department of the Ind. Metallurgy at the University, Birmingham.

Testing the Gas-content of Molten Metals

sphere, per hour. The extraction was carried out at a temperature of 590 deg. and was usually completed in two hours.

Results

(*a*) The true gas-contents of the alloys, Table I, were determined by direct measurement in the apparatus as described earlier, whilst the experimental porosity per cent. was determined from density samples using the following relation:

$$\text{Per cent. porosity} = \frac{\text{Theoretical density—Experimental density}}{\text{Theoretical density}} \times 100$$

The results of experiments obtained with the three Al/Si alloys and with commercially-pure

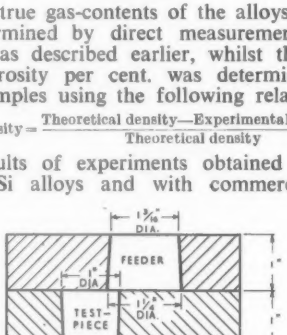


FIG. 1.—*Density gas-test mould, made in sand by the CO_2 Process.*

aluminium are recorded in Table I, whilst the corresponding graph is seen in Fig. 3.

TABLE I.—*True Gas-content of Chill-cast Samples in ml. per 100 gm. and the percentage Porosity of the Corresponding Density. Test-pieces at Different Stages of Degassing. (Melts degassed at 750 deg. C. by a stream of nitrogen passed at the rate of 1 litre per min.)*

Material.	Degassing Time, in minutes.				
	0	1	2	4	8
Commercially pure Al — Percentage porosity	5.492	3.193	2.986	2.106	0.442
Commercially pure Al — Gas-content	0.85	0.62	0.56	0.44	0.23
1.7 per cent. Si/Al — Percentage porosity	4.543	2.180	1.736	1.109	0.150
1.7 per cent. Si/Al — Gas-content	0.72	0.48	0.39	0.34	0.19
6 per cent. Si/Al — Percentage porosity	5.917	1.752	1.377	1.079	0.632
6 per cent. Si/Al — Gas-content	0.77	0.44	0.36	0.33	0.26
12 per cent. Si/Al — Percentage porosity	3.872	2.557	1.504	1.015	0.263
12 per cent. Si/Al — Gas-content	0.62	0.50	0.39	0.279	0.17

Gas-content of Density Samples

(*b*) The true gas-contents of the density samples were also determined by the extraction method and are given in Table II, for commercially-pure Al. The gas-contents given in Table II, were actually obtained from the density sample, the percentage porosity of which is given in Table I.

TABLE II.—*True Gas-contents of the Density Samples in Commercially-pure Aluminium.*

	Degassing time in minutes.				
	0	1	2	4	8
Gas-content, ml./per 100 gm.	0.91	0.65	0.53	0.41	0.23

Density of Gas-free Alloys

(*c*) The percentage porosities of the alloys were calculated on the basis of the theoretical densities which were determined from densities and proportions of the alloying constituents present by using the mixture rule. Some additional experiments on degassing aluminium melts by nitrogen in an electric furnace had shown that the maximum density is reached after 20 min. degassing. Such experimental maximum densities for the different alloys are compared in Table III with their theoretical densities. The gas-content of a melt of commercially-pure aluminium, after 20 min. degassing with nitrogen was found to be 0.13 ml. per 100 gm.

TABLE III.—*Comparison between Experimental and Theoretical Densities*

Alloy.	Density in gm. per cc.	
	Experimental.	Theoretical.
Commercially-pure Al ..	2.713	2.713
6 per cent. Si/Al	2.686	2.687
12 per cent. Si/Al	2.660	2.660

Effect of Preheating the Density Mould on Resultant Porosity

(*d*) The gas-contents were also obtained on specimens referred to in Table III. The results showed that samples having maximum density actually contained 0.109 ml. of gas per 100 gm. of metal. This indicates that an appreciable amount of gas can be retained in solid solution and does not contribute to porosity. It was of interest to test the effect of mould temperature on the relative proportions of gas which is retained in solution and that which separates into gasholes. The density samples were cast into moulds held at three temperatures, 25, 250 and 500 deg. C.

A range of porosities was covered by repeating the experiments with melts degassed for 2 and 10 min. respectively; the results are shown in Table IV.

TABLE IV.—*Porosities of Commercially-pure Aluminium cast into Moulds at Various Temperatures, Gassed and Degassed.*

Temperature of mould.	Per cent. Porosity (Com. Pure Al).		
	Gassed condition of the melt.	Melt degassed for 2 min.	Melt degassed for 10 min.
Room temperature			
25 deg. C. ..	3.585	1.957	0.000
250 deg. C. ..	3.848	2.390	0.63
500 deg. C. ..	3.881	2.439	0.66

Comments on the Results

The major point which arises from the experimental work is the assessment of the density test as a gas-control test " on the foundry floor." In

addition, some interesting deductions can be made on the problem of gases in light alloys.

One of the assumptions made originally by Ohira and Kondic[1], implied that the density sample contains all the gas (or most of it) which is present in the melt. The results shown in Table II when compared with those shown in Table I, reveal that this assumption is met, and that little gas is lost from the density sample during the casting process.

In the second assumption which was made concerning design of the mould for density sampling, it was argued that any density deviations from the maximum density are due to the gas liberation from the metal and not to any solidification shrinkage. The results given in Table III confirm this assumption: density samples obtained from fully-degassed alloys give density values equal to the theoretical or calculated density. The same values for theoretical densities were obtained by forging or rolling the alloys used, in order to ensure maximum soundness of the sample, and measuring the density.

The third assumption which was made originally with the density gas-test is perhaps the most important one: during the slow-freezing process, the gas which was originally dissolved with molten metal, separates out and forms porosity in the density sample, thus most of the gas should be found in gas holes, except that fraction of the total gas which is soluble in the solid metal. There are several ways in which this assumption could be checked.

First, a plot of percentage porosity obtained from the density samples against the true gas-content, should be a straight line with an intercept on the X-axes giving the value of the equilibrium solubility of hydrogen in solid aluminium. The graph actually obtained, shown in Fig. 3, reveals such a straight-line relation but, it contains two deviations from the theoretical predictions: first, the intercept value on the X-axes is 0.13 ml. per 100 gm. instead of the anticipated value of 0.036 ml. per 100 gm. instead of the anticipated value of 0.036 ml. per gm., and secondly, at larger gas-contents, the straight-line relation breaks down. Consequently, it appears that hydrogen gas in amount above the quantity necessary for equilibrium solid solubility is retained in solid solution, even in a slowly-cooled density sample.

This point appears of major significance and merits a more extensive examination. It can be seen from the preliminary results recorded in this work, that some of this supersaturated gas can be made to contribute to the formation of porosity, as for example, by raising the mould temperature of the density sample. This is shown in Table IV, which reveals that lower densities, *i.e.* higher-porosity values correspond to the higher mould temperature. However, even with this slower rate of cooling it was found by absolute gas measurements that not all of the supersaturated gas comes out into the gas holes.

Another method of analysing this problem is that of converting the values of the true gas-contents into the percentage porosity, and comparing the values thus obtained with those obtained directly by density determinations. This can be done by finding the volume of the true gas-content at the solidification temperature and pressure of one atmosphere and then converting such values into the percentage porosity. The values of the

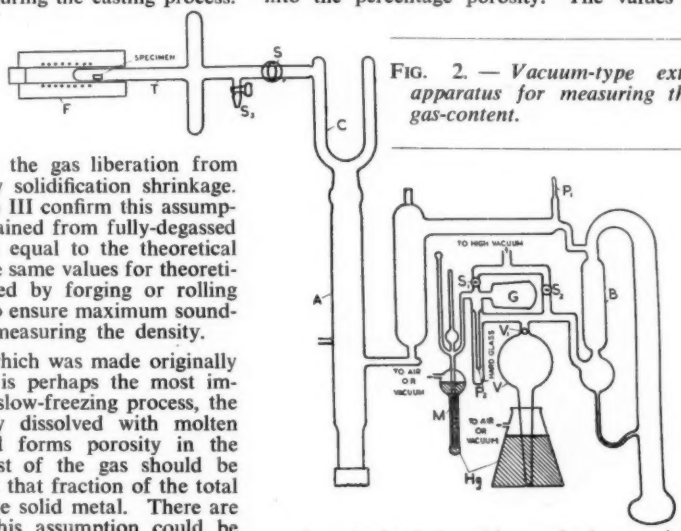


FIG. 2. — *Vacuum-type extraction apparatus for measuring the true gas-content.*

results obtained by this method are shown in Table V.

Admittedly, such a conversion of true gas-content into porosity rests on uncertain values of two quantities: that of temperature and pressure values involved, but the results are, nevertheless, of interest and show that even after allowing for the equilibrium gas retained in solid solution, the expected or calculated porosity, if all the gas did come out into gas holes, would be greater than the observed porosity.

TABLE V.—*Comparison of the Experimental and Theoretical Porosities Based on Gas-content.*

Alloy.	Porosities at different degassing times (in minutes).					
		0	1	2	4	8
Commercially pure Al.	Theoretical ..	6.386	4.529	3.919	2.876	1.045
	Experimental	5.492	3.193	2.986	2.106	0.442
1.7 per cent. Si/Al	Theoretical ..	4.795	3.773	2.202	1.808	0.629
	Experimental	4.543	2.180	1.736	1.109	0.150
6 per cent. Si/Al	Theoretical ..	5.150	2.575	1.951	1.717	1.170
	Experimental	5.917	1.752	1.377	1.079	0.632
12 per cent. Si/Al	Theoretical ..	4.013	3.000	2.156	1.231	0.463
	Experimental	3.872	2.557	1.504	1.015	0.2631

With the larger gas-contents in the melt, as seen in Table V, the expected porosity and that obtained with the density sample converge to the same value. A possible explanation of this feature is that with larger gas-contents the porosity starts forming during the early stages of solidification and in this

way most of the gas comes out. Both the diffusion and resistance to bubble-formation factors are in favour of larger values of porosity being obtained under such conditions.

Apart from these observations relating to the characteristics of the density gas-testing, two additional points emerge from this work. First, it was shown with the commercially-pure aluminium that appreciable amounts of gas are left in the metal even after the degassing process of 20 min. in an electric furnace. It was not possible by normal nitrogen degassing to reduce the hydrogen content below 0.13 ml. per 100 gm. which is a value well above the equilibrium solid-solubility of hydrogen in aluminium, *i.e.* 0.036 ml. per 100 gm. Secondly, the graph relating percentage porosity and the true gas-content, Fig. 3, is the same for all the alloys tested, within the experimental accuracy of the absolute gas-determination. The significance of this observation is discussed in what follows.

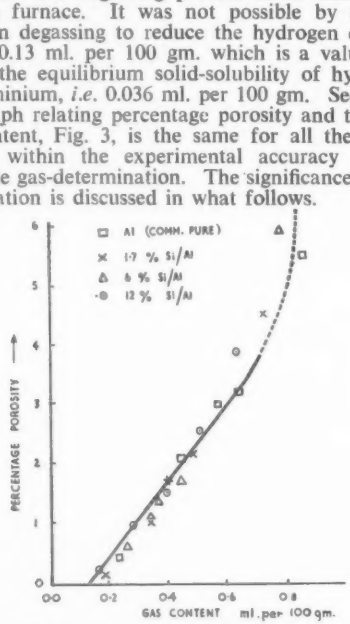


FIG. 3.—*Relation between porosity and the true gas-content for aluminium and aluminium/silicon alloys.*

Gas-testing " on the Foundry Floor "

From the point of view of foundry applications, the gas test should satisfy the following requirements, if it is going to find extensive use in the foundry itself: (*a*) so that sensitivity and reproducibility are fully met, the test should be simple, quick and inexpensive, and (*b*) it should provide quantitative information which could be immediately used to correct for any unsatisfactory application of the molten metal—before this led to the production of scrap castings.

The latest advance in the direction of gas-testing, is the apparatus proposed by Ransley[6], in which the gas-content of a melt is directly measured by passing through it a small volume of a neutral gas, and then obtaining the amount of hydrogen in this gas by measuring the change in electrical conductivity. There is little doubt that this is the ideal approach to the problem of gas evaluation, but unfortunately there has been yet little published concerning this apparatus, which would enable it to be assessed for general foundry applications from the point of view of arguments advanced above.

Even assuming that Ransley's method is going to provide the best solution to gas-testing, as it may well do so, the Authors of this article believe that the work on alternative methods for gas measurement should be continued and for the following reasons: first, it is desirable to have an alternative test which can be applied for checking or substituting for any other similar test when the need arises, and secondly, it may well be that Ransley's method will not be applicable to all alloys, and thus an alternative test would be useful in such cases.

The density-gas test as proposed by Ohira and Kondic may be developed as a gas test for foundry-floor applications. The major criticism of this test is that it needs some time—of the order of 3 to 5 mins.—to perform the density measurement; a balance is also required (an instrument not readily looked after in a sand foundry!). It is quite possible to simplify the density measurements—as is well shown by some recent work[7], where a gravitometer is described by means of which the density could be determined rapidly and directly by reading from a scale.

Another criticism of the density-test for gas estimation is that it does not give the true gas-content. One solution of this problem can be readily suggested, namely, that the density values can be calibrated in terms of the true gas-content, as shown in Fig. 3. Such a graph is characteristic for a given density-mould design and experimental procedure—and once established by means of the vacuum-extraction apparatus, it appears to hold for most aluminium-base alloys. Similar graphs no doubt could be readily established for other alloys.

A test which is used frequently for gas estimation particularly in light-alloy foundries, makes use of the principle of solidification under partial vacuum in order to magnify the extent of gas porosity. This test is known as the Pfeiffer test and it is sometimes followed by density determinations of the sample. The results obtained in this work show that for gas contents > 0.11 ml. per 100 gm. in aluminium-base alloys, there is no need for vacuum solidification in order to detect the presence of gas. By increasing the mould temperature the gas contents of the order ≥ 0.04 ml. per 100 gm. can be determined. As the solubility of hydrogen in solid Al is 0.036 ml. per 100 gm.—this means that the Pfeiffer test offers an advantage over the test described in this work for the gas content range 0.04 ml. per 100 gm. to 0.11 ml. per 100 gm., if the density mould is used at room temperature. When using a heated density mould, the Pfeiffer test offers no advantage over the solidification test at atmospheric pressure.

Acknowledgments

The writers wish to express their thanks to Professor A. J. Murphy, who until recently held the chair in the Department of Industrial Metallurgy at Birmingham University, for his encouragement

(*Continued on page 366 at foot of col. 1*)

Notes from the Branches

Tees-side

Since the last report of its activities, the Tees-side branch of the Institute of British Foundrymen has held three meetings. On February 10, Mr. G. J. Rogers, of Southsea, gave a very interesting lecture on "Foundry Problems and Principles." This meeting was very well attended and members were impressed by the practical information which Mr. Rogers had collected. On March 9, Mr. H. Hart gave his paper on "Aspects of Steelfoundry Practice" to a large audience. His main points were illustrated by slides, which served to round off an interesting paper.

On April 13, the branch held its annual general meeting and presentation of prizes to winners of the various sections of the Apprentice Competition. At the "business" side of the meeting the following officers were elected:—As *president:* Mr. A. P. Riley; as *senior vice-president:* Mr. John Vickers; as *junior vice-president:* Mr. J. N. P. Downing; as *secretary:* Mr. Frank Shepherd; as *general Council representatives:* Mr. J. K. Smithson and Mr. H. Marshall.

Congratulations were expressed to the retiring president, Mr. Frank Shepherd, J.P., on an excellent year of office; he had combined very successfully the dual duty of president and secretary.

Apprentice Competition

After the general meeting, in the Teesdale Hall of Head, Wrightson & Company, Limited, where a large number of moulds and castings made by competitors were on display, an open meeting was held. This was attended by prizewinners, competitors, works supervisors, and parents of the boys. There were in all 143 entrants for the competition, an increase on the numbers in the previous two years. An extra section had been incorporated this year—a written-paper competition.

Mr. Frank Shepherd, the president, opened the proceedings and referred to the interest which had been aroused in 1954, when the first Apprentice Competition had been organized. Since that time a few other branches throughout the country had held similar competitions and Tees-side had been asked for both assistance and advice in this direction. He considered it a feather in the cap of the branch that it had held the first Apprentices' Competition. In these days of automation, it was particularly pleasing to see that youths could still produce, by hand, articles representative of one of the world's most ancient crafts, founding; the more so since Tees-side is famed for its foundries. It was also pleasing to see that the youth of the area were acquiring both the practical and technical knowledge required to produce as good work as their fathers had done in the past. A great deal of work had been put into this competition by members of the apprentice committee and the results proved that the youth of the area were greatly encouraged by it.

Mr. Riley, chairman of the Apprentice Competition committee, gave a report on this year's competition. He said that the audience would see that prizes had gone to apprentices from quite widely separated foundries. Entries, received from 25 different firms, had shown an increase in both the cast-iron and steel sections, but not in that for patternmaking. The non-ferrous entries were small in number but of high standard considering that there were very few foundries of this type in the area. The written paper had not attracted as many entries as had been expected, but this was the first year it had been tried. The quality of the papers received had, however, been excellent.

Mr. Riley expressed thanks to the judges, who were:—*Steel:* Dr. Dadswell; *iron:* Mr. J. Nicholls and Mr. T. McCusker; *non-ferrous:* Mr. Timms; *patternmaking:* Mr. L. Brown; and *written paper:* Mr. J. Currie.

Mr. Frank Shepherd then asked Mr. W. S. Scott, of the Darlington Forge, Limited, to present the prizes. Mr. Scott said that in these days of progress it was good to see apprentices take such an interest in their particular craft. Despite the large amount of theoretical knowledge available in the foundry world to-day there was no real road to success in the ancient science of founding unless the men had practical experience as well. He asked that parents would encourage their sons by taking an interest in their work and also in their attendance at evening classes.

Prizes were then presented as follow:—

Patternmaking: 1st, K. Lees, J. Vickers & Son; 2nd, R. Harrison, J. Vickers & Son; 3rd, J. K. Morris, Richardsons Westgarth, Limited; 4th, E. Robertshaw, Skernside Patternmaking Company.

Steel moulding: 1st, M. Pincher, Wilsons Forge, Limited; 2nd, L. Whinn, Head, Wrightson, Limited; 3rd, C. Gilbey and J. Irving, Wilsons Forge, Limited.

Cast-iron moulding: 1st, P. B. Scott, Ashmore, Benson, Pease, Limited; 2nd, B. T. Sullivan, Tees Foundries, Limited; 3rd, J. Walker, Ashmore, Benson, Pease, Limited; 4th, J. F. Cowland, Cochranes, Limited.

Non-ferrous moulding: 1st, G. Vickers, Daralum Castings; 2nd, P. Goldsborough, Reay Brass Foundry.

Written paper: 1st, M. M. Gray, Darlington Forge, Limited; 2nd, B. Butler, Head, Wrightson, Limited; 3rd, D. Craig, Darlington Forge, Limited.

Mr. M. M. Gray, winner of the written-paper competition, then read his paper to the meeting. The subject he had chosen was "Steelmaking in the Acid, Open-hearth Furnace."

Some of the winners in the apprentice competition organized by the Tees-side branch of the Institute of British Foundrymen:

Back Row (left to right): Mr. M. Harrison; Mr. M. Gray. *Front Row:* Mr. E. Robertshaw; Mr. K. Lees; Mr. D. Craig; and Mr. G. Vickers.

(Courtesy, "The Northern Echo.")

Notes from the Branches

MR. SHEPHERD congratulated Mr. Gray on his paper and the efforts he had made to make it both interesting and enlightening. He asked members of the audience who were interested to attend any of the branch's lectures and extended the invitation to apprentices from the various works. He expressed gratitude to the syllabus secretary, Mr. Chadwick, who by his efforts had done so much for the branch.

London

The London branch of the Institute organized a special meeting for apprentices on April 11 at the Waldorf Hotel, London. Almost 80 firms, including technical colleges, were circularized and apprentices from works within the London area, particularly those from foundries, were invited to attend. About 162 apprentices accepted the invitation and of this number, 100 came in parties with their supervisors. The Apprentice Competition held last year was very enthusiastically supported and the idea behind this year's meeting was to continue the friendly association between apprentices and the London branch which started then. Mr. A. Talbot, of Western Foundries, who is always popular with youthful audiences, had agreed to be chief speaker and he was supported by a panel of branch members prominent in various phases of foundrywork and comprising Mr. B. Levy, Mr. E. Daybell, Mr. D. Morris, Mr. F. McKenning and the branch president, Mr. F. Hudson.

Opening the meeting, Mr. F. Hudson first introduced the panel to the audience and Mr. Talbot gave a brief introductory talk. Then members on the panel each outlined their particular experience of foundrywork and told the boys of the precepts they had followed in their careers. Mr. Talbot next showed the patterns and the lantern slides of the winning castings in the Apprentice Competition held last year and after that there was a break for refreshments, coffee, sandwiches and biscuits being served. Resuming the meeting, there was a very long and well-informed exchange of information between the audience and the panel (about 20 boys taking part). In fact, the quality of the discussion was comparable with that of any branch meeting discussion. At the close, the president thanked the boys for coming along to the meeting and said he hoped that they had enjoyed it as much as he had himself. He also expressed the personal view that this evening might well be the forerunner in a regular series and thanked the panel for their assistance in making it such a success.

Testing the Gas-content of Molten Metals in a Foundry

(*Continued from page* 364)

and advice, and to Dr. C. E. Ransley for his great help in the construction of the gas-extraction apparatus and to Mr. B. B. Bach for helpful discussion.

REFERENCES.

[1] Ohira, G. and Kondic, V., FOUNDRY TRADE JOURNAL, 1954, **96**, p. 331.

[2] Eborall, R. and Ransley, C. E., *J.* Inst. Metals, 1945, **71**, 525.

[3] Speight, G. E. and Cook, R. M., *J.* Iron and Steel Inst., 1948, **160**, 397.

[4] Carney, D. J., Chipman, J. and Grant, J. J., *Journal of Metals*, 1950, **2**, 404.

[5] Ransley, C. E. and Neufeld, H., *J.* Inst. Metals, 1948, **74**, 599.

[6] Ransley, C. E. Patent No. 684865 and application No. 23254/51.

[7] Rosenthal, H. and Lipson, S., *Trans.* Am. Found. Soc., 1955, **63**, 361.

British & World Shipbuilding

Lloyd's Returns for March Quarter

Steamships and motorships under construction in Great Britain and Northern Ireland at the end of March totalled 355 ships of 2,260,949 tons gross, an increase of 34,759 tons compared with the previous quarter, states Lloyd's Register of shipbuilding returns for the quarter ended March 31 relating to merchant ships of 100 tons gross and upwards. The vessels included 109 steamships of 1,309,496 tons, and 246 motorships of 951,453 tons. In other British Commonwealth countries there were under construction 15 steamers of 27,895 tons, and 32 motorships of 77,908 tons. Oil tankers building in Great Britain and Northern Ireland in the March quarter totalled 71 ships of 945,264 tons, an increase of 3,439 tons compared with the previous quarter. The figure represents 41.8 per cent. of the total tonnage under construction in this country. Vessels building in the world numbered 1,530, of 7,009,179 tons (including 6 wooden ships of 759 tons), compared with 1,452 of 6,612,641 tons in the December quarter. The total included 305 steamers of 3,064,371 tons and 1,219 motorships of 3,944,049 tons. Construction in hand in the principal districts of Great Britain and Northern Ireland is indicated in Table I.

TABLE I.—*Vessels Under Construction in Principal Districts of Great Britain and Northern Ireland.*

District.	March 31, 1956.		December 31, 1955.		March 31, 1955.	
	No.	Gross tonnage.	No.	Gross tonnage.	No.	Gross tonnage.
Aberdeen ..	19	21,755	19	21,002	17	27,455
Barrow ..	3	83,140	4	95,340	5	107,140
Belfast	22	261,731	23	270,130	17	211,250
Bristol ..	4	2,660	5	3,410	4	2,070
Clyde—						
Glasgow ..	75	459,127	74	469,490	72	465,684
Greenock ..	31	218,553	31	191,277	33	215,710
Dundee ..	5	36,410	6	44,410	6	34,610
Hartlepool ..	7	47,488	8	51,917	7	39,884
Hull	37	21,001	39	20,866	31	16,618
Leith	15	56,640	16	50,654	15	49,560
Liverpool ..	23	196,070	18	154,341	20	150,768
Middlesbrough	13	194,600	12	178,250	15	197,050
Newcastle-upon-Tyne ..	37	397,066	40	391,385	39	399,330
Southampton ..	5	1,648	4	2,336	4	2,084
Sunderland ..	32	249,143	34	267,330	27	212,790

The sizes of steamships and motorships in parentheses under construction in Great Britain and Northern Ireland included the following:—100 to 1,000 tons, 14 steam (103 motor); 1,000 to 2,000 tons, 3 steam (23); 2,000 to 4,000 tons, 3 steam (17); 4,000 to 6,000 tons, 7 steam (19); 6,000 to 8,000 tons, 13 steam (33); 8,000 to 10,000 tons, 12 steam (33); 10,000 to 15,000 tons, 17 steam (15); 15,000 to 20,000 tons, 10 steam (3); 20,000 to 25,000 tons, 26 steam (nil); 25,000 to 30,000 tons, 2 steam (nil); 30,000 tons and above, 2 steam (nil).

Of the steam and motor merchant ships under construction throughout the world at the end of March, 4,297,298 tons (61.3 per cent.) are under the inspection of Lloyd's Register. Of this total, 2,095,948 tons, representing 92.7 per cent. of the tonnage being built there, are under construction in Great Britain and Northern Ireland, while, of the tonnage being built abroad, 2,201,350 tons (46.4 per cent.) are to be classed with Lloyd's Register of Shipping.

THE second International Congress on Acoustics is to be held in Cambridge, Massachusetts, from June 17 to 23.

National Foundry College—Its Origin and Purpose

(From a Correspondent)

The 1956 " Open Day " at the National Foundry College is to take place on Thursday, May 31, when, also, College Diplomas will be presented to successful students. The approach of these two occasions prompts the reflection that the foundry industry as a whole has never fully used the valuable post-graduate training that the College can give to carefully selected students of the right kind. This is probably due on one hand to insufficient knowledge of the reasons which make the College of more importance to the industry to-day than possibly at any previous period in its existence, and on the other to the fact that many foundry managements have never clearly defined who is best able to benefit by the training given. It is with the object of stimulating thought on these two aspects of the problem that this article has been written.

Eight years ago, in January, 1948, the National Foundry College opened for its first session beneath the hospitable roof of the Wolverhampton and Staffordshire Technical College. Six years after, in February, 1954, it moved into its own new buildings on an adjacent site generously given up for this purpose by the Technical College authorities. In this way was justified the vision of the men who pioneered higher education for the foundry industry in Great Britain. Justified, that is to say, in bricks and mortar and equipment. These things, essential as they are, are but the accessories and instruments of teaching. The proof of their value is in their use, by the teachers and the students. The College has the teachers; it needs many more students from the British foundry industry, ferrous and non-ferrous.

A Matter of Urgency

It needs them because the call for more men fit to take the higher executive positions in the industry is urgent. It was becoming urgent before the College existed, and the urgency increases with the passing years. To-day there is universal recognition that technical and economic factors are fast changing the face of all industry. Founders and foundries cannot contract out of this change. Home and export customers for all kinds of castings are themselves involved in the process; they will expect the foundry to keep pace with them. Craft skill by itself is not enough; there is a necessity, at least for those destined to fill the highest places, of some form of post-apprenticeship training akin to that provided by the science and engineering faculties of the great universities. It was to give this kind of education that the National Foundry College was called into being. If the industry really values its future, if it genuinely fears either the danger of substitution and fabrication or the absence of a future generation of leaders, it should, and would, make more use of the higher education provided at Wolverhampton.

The need for higher foundry education—that is, education for the posts carrying the highest responsibilities in the industry—was first realized in the 'thirties. In 1935, various representative bodies, notably the British Cast Iron Research Association and the Institute of British Foundrymen, in co-operation with the Ministry of Education, established the British Foundry School in the premises of the Birmingham Technical College. The School offered a full-time course lasting a year; successful students were awarded the British Foundry School Diploma. This Diploma was being internationally recognized as an outstanding qualification, when this first effort at providing higher foundry education was brought to an end by the second world war.

During the war, however, the ideal inspiring the founders and the Governors of the former Foundry School was kept alive. This led to the revival of the scheme in January, 1948, as the National Foundry College, with a single session diploma course similar to the pre-war one. Already at this stage, the need was apparent for a syllabus of training wider and longer than could be fitted into a single session. The College course was therefore divided into two parts, with a higher final standard.

The continuing reasons for having a National Foundry College of the kind that has evolved on the lines outlined above are three: (1) The foundry industry is a major basic industry spread through many districts; (2) nowhere is it concentrated enough to provide sufficient students locally who would be capable of profiting by a course of the highest standard; (3) yet such a course is necessary for an industry desiring to progress at the same rate as its customers. The method chosen has therefore been to establish one college, centrally situated, in order to provide top-grade technological education for students from every part of the United Kingdom.

The College buildings are spacious and well provided with every necessary aid to instruction. The teaching staff is adequate and highly qualified; the curriculum is well arranged. Its activities are directed by a Board of Governors, the majority of whom are widely representative of the whole industry, and also of professional bodies concerned with those other industries for which the foundries work. This composition in the Board of Governors is of importance; it is the guarantee of the practical as well as the theoretical soundness of the instructions given, of its relationship to the needs of the foundry industry.

Sources of Students

Up to the beginning of March, 1956, 132 students had completed the Diploma course; of these 123 had been awarded Diplomas. At the time of writing, 16 are attending part one of the course and

National Foundry College—Its Origin and Purpose

26 are taking part two. Of the 132 who have completed the course, 26 have come from abroad. The majority of the home students have been sponsored and maintained at the College by their employers, although a few have been "independents," in receipt of financial aid from the Governors, the Local Education Authorities, the Institute of British Foundrymen, or the Worshipful Company of Founders. These, and the overseas students, are, of course, welcome to the College facilities and privileges. It is nevertheless right that the majority should be employer-sponsored students from this country. The College was established to serve the industry as such; it would seem, therefore, that the best results are likely to be attained if foundry undertakings nominate and support their own qualified men. They thus benefit directly from their far-sightedness.

It is difficult to supply exact information of the proportions in which different branches of the industry make use of the College. Many firms cover more than one branch—a company may make castings in both iron and light alloys, or in iron and steel. Approximate figures are 70 per cent. from ironfounding, 12 per cent. steel, 10 per cent. light alloys and 8 per cent. non-ferrous (copper-base, etc.). These percentages are of interest relatively, but in the absolute sense they are of little significance. Whatever may be the ratio of students from different kinds of foundries, the important fact is that the foundry industry is not gaining from the College the advantages that it might enjoy if it used the organization to the fullest possible extent.

The chairman of the Governors, Sir Frederick Scopes, in a recent speech, said that they had been perturbed that the level of educational attainment of candidates for admission was not always sufficiently high. He added that there were numerous companies, large and small, which might need the services of men with a training of the kind the College can provide, yet a large number of these firms had not sponsored students since the College was established after the war. In the same speech he expressed doubt whether the facilities available at the College were adequately known throughout the industry.

Does the industry appreciate the need for men with the advanced training and qualifications offered by the National Foundry College? If so, the industry must attract recruits of the right calibre, and the opportunity of advanced technological education can be one of the greatest incentives to this end.

Plate Castings in Spiegeleisen

Amongst the foundry problems discussed at a special meeting of the South African branch of the Institute of British Foundrymen, was the question of how to make, in spiegeleisen, plate castings which were used in the manufacture of safes.

The discussion was opened by MR. COOMBS, who remarked that spiegeleisen being very hard would probably have a very high shrinkage. It had been mentioned that unless precautions were taken, a casting in this material could be broken with a small hammer. He thought that internal stress would play an important part in the production of such a casting and any of the usual methods of reducing stress during casting would be of help. When combining the stress problem with that of shrinkage, it was obvious the casting would have to be carefully fed and temperature gradients kept as even as possible. Like most plate castings, there was the danger of scabbing and possibly to use a dry-sand mould would be of some help; furthermore to feed properly the metal would have to be poured at the highest possible temperature. Finally, to reduce all stress to a minimum the casting would have to remain in the mould until quite cold.

MR. DE KIEWIET referring to contraction and the use of a dry-sand mould, asked Mr. Rounce (who had the job of making such castings) if he would consider the use of an oil-sand mould which would readily collapse and allow the casting complete freedom to shrink without cracking. He did not think that up- or down-hill casting would make a great deal of difference, as the mould filled from the bottom edge first in either case.

Practical Method

MR. ROUNCE said he had made a good many experiments before being successful in making these castings. The metal was fairly sluggish to pour and had to be cast from the same cupola which produced iron for normal jobbing foundry production. It was found that a very hot cupola helped to overcome the sluggishness but metal contamination developed. To combat the poor fluidity, he used runners all along each side of the plate, and two ingates. The plate being 1¼-in. thick, the runners were about ⅞-in. deep and about 2½-in. wide; on a run of 4 ft. about ten runners were used to get in quickly as much metal as possible. Brittleness of the metal was a very serious factor, but was overcome by casting into the plate a grid comprised of $\frac{3}{16}$-in. rods. Green-sand was used, the grid was laid in, the mould closed and the metal poured in at a very fast rate; the grid held the casting together.

To provide for the cutting of ⅝-in. dia. rivet-holes, small grey-iron buttons were cast. The grid, when manufactured to the customer's drawings, had spaces in it where the holes were to be and when it was placed in the mould the cast-iron buttons were set in place.

MR. BOUSTRED said he had also been associated with the safe-making industry and had used Scaw metal which was extremely brittle. He asked Mr. Rounce how the cupola lining stood up to melting such metal, what moulding sand was used and what was the approximate manganese content.

MR. ROUNCE replied that he did not use any dressing on the mould but it should be borne in mind that in England naturally-bonded moulding sand was used. This sand stood up to repeated casting and was cheap to use. He went on to say that the cupola lining eroded rather badly when melting spiegel and added that, bearing in mind that setting was very rapid, a high temperature of the metal was no guide to the condition of this casting when finished.

MR. COOMBS asked if at any time any trouble was experienced with hot-tearing from the grid.

MR. ROUNCE replied that he had no such trouble, as the grid prevented anything like that. The plates could be treated quite harshly and dropped without breaking. The grid used actually had a weave like that of basketwork and he suggested this solved the problem of breakage or hot-tearing of the plates.

Epuipment and Supplies

Electrically-heated Screens*

The Berry Hill Quarry of the Mansfield Standard Sand Company, Limited, contains, apart from the well-known naturally-bonded moulding sand of Bunter origin, a coarser grade of sand requiring dry screening to obtain a satisfactory product for its various uses, mainly in the building trades. This sand lies primarily between Nos. 44 and 120 BS sieves with a 4 to 5 per cent. well-distributed clay and moisture varying between 7 and 10 per cent. Sand is delivered from the quarry by field conveyor to a primary hopper from which the sand feed is controlled in proceeding to the screening plant. The latter comprises three Pegson Telsmith vibratory screens, each 10 by 4 ft. with three frames per screen. Effective precautions are taken to provide equal distribution of sand to each screen, where baffles ensure an even flow over the full width of the mesh.

Before the application of electric screen-heating, the screens were all of slotted mesh $1\frac{1}{2}$ by $\frac{5}{16}$ in. by 14 swg. which gave an average throughput per screen of 20 to 25 tons per hour. Each screen had to be brushed manually with wire brushes at frequent intervals to eliminate continual "blinding" caused by the moist conditions and nature of the sand. This cleaning process involved attendant labour costs and considerable wear on the screens cloths, together with a great tendency to overspill material other than rejects, as a result of the "blinding."

The screen heating system (Fig. 1) engineered and installed by Woden Transformer Company, Limited, of Moxley Road, Bilston, Staffs, has provided several advantages, it is claimed. Improved quality of product has been attained by reduction in mesh size to $\frac{1}{2}$ by $\frac{1}{2}$ in. by 14 swg., together with a 30 to 40 per cent. increase in throughput. Moreover, the elimination of "blinding" and its attendant brushing for these rates of screening resulted in an overspill of "true rejects" only, varying between $2\frac{1}{2}$ and $7\frac{1}{2}$ per cent.

An electric transformer (Fig. 2) is applied to each screen, under balanced loading conditions, from a supply voltage of 440 v., 3 phase, 50 cycles, and by passing heavy electric current through the mesh wires at low voltage, a uniform heat is obtained over the whole area of the screen. The transformer is air-cooled and fully weatherproofed. The current rating depends upon the size of the mesh of the screen, the temperature of the raw material and its moisture content and to accommodate all such variables, tapped transformers were provided, giving various current ratings.

It has been found in practice that with each screen running at 30 tons per hour throughput, electrical consumption is of the order of 0.5 units per ton per hour, indicating that running costs are extremely low. Additional savings have also been gained in longer screen life, reduction of attendant labour, and greater output of material of consistently higher quality.

* See also p. 238 of the April 26 JOURNAL.

Precision Thickness-gauge

Dawe Instruments, Limited, 99, Uxbridge Road, London, W.5, have extended their range of ultrasonic thickness-gauges, and a new model, type 1107B Visigauge, has been introduced. This operates on the ultrasonic resonance principle by which thickness of components, of which only one side is accessible, can be measured non-destructively. Direct-reading scales are available for the measurement of thicknesses between 0.005 and 2.5 in. with an accuracy of between ± 0.0005 and ± 0.003 in. Even higher accuracy can be achieved over limited ranges, and measurements to within 0.1 per cent. of the actual thickness can be obtained for some applications. With this instrument, wall thicknesses in the most awkward locations can thus be measured with better than micrometer accuracy.

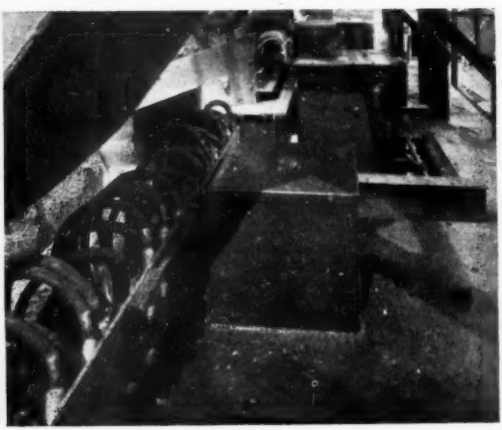


FIG. 1 (LEFT).—*Screening section of the Berry Hill plant of the Mansfield Standard Sand Company, Limited, showing (ringed) the location of the electric heaters.* FIG. 2.—*Close-up of the section (ringed in Fig. 1) where the transformers and cables are applied to the vibratory screens.*

Book Reviews

Manganese Steel. Published for Hadfields Limited, by Oliver & Boyd Limited, Tweedale Court, Edinburgh, 1; price 18s. net.

This book is an interesting account of the discovery and development of manganese-steel, now recognized as the first of the austenitic type. It is thoroughly practical and though the publishers are makers of manganese steel it is unbiased. For instance, one table shows that nickel/chromium cast-iron is superior for use in sand mills. The material is well known to have excellent foundry properties, and the reviewer was recently at a loss, when visiting a Continental plant, to understand the poor surfaces shown by manganese-steel, when all other types gave excellent results.

The subject is comprehensively covered, and some of the figures of "life" given in connection with railway permanent-way traffic are indeed illuminating. It is related that "One such crossing at British Museum Station on the Central London line was in use for 14 to 15 years, during which time at least 700 million tons of traffic passed over, as compared with the life of six to eight weeks for the fabricated crossings previously used." The reviewer was interested in Sir Robert's early attempts to cast, by centrifugal methods, a layer of manganese-steel on ordinary railway tyres. Some 30 years ago an American foundryman attained a considerable reputation for making various jobs by casting them in mild steel and then enlarging the mould and filling the interspace with a special steel. It was operated as a secret process and lasted for a number of years.

The book runs to 128 pages and is splendidly illustrated, the photomicrographs being outstanding. It can be recommended to either those who have to use manganese-steel or the various founders who make it. The former will find some good notes on welding, whilst the latter will have several helpful chapters.

Metallurgical Thermochemistry, by O. Kubaschewski and E. L. Evans; published by the Pergamon Press, Limited, 4/5, Fitzroy Square, London, S.W.1; price £2 15s.

This is a book for metallurgical chemists and not for amateurs. It is based on chemical thermodynamics which recognizes the free-energy concept as a measure of the driving force by which metals and their compounds react. The positions of the phase boundaries in an alloy system are also determined by the free-energy relationships between the various phases. Free energies may be evaluated by such measurements as heats of formation of alloys, equilibrium constants of reactions, and voltages generated by reactions which can be made to produce currents in a galvanic cell. The use of such data in developing methods of metal production was made evident in the 1950 Refresher Course of the Institution of Metallurgists, but the present work deals more particularly with the data itself and experimental methods of determination.

The first edition of this monograph appeared in 1951, and it is a measure of its value and of the interest which is being taken in the subject that a new edition has been called for five years later. This takes account of the latest researches and includes many new results—in fact the tables at the end cover 128 pages and there are 340 references. Six examples are given of the thermochemical treatment of metallurgical problems, of which the deoxidation of steel will interest some founders, whilst the reducibility of MgO is applicable to the behaviour of a magnesia crucible when used for melting. **H. O'N.**

New Catalogues

Screw-thread Forms of the World. A very useful guide to this subject has been issued by W. H. A. Robertson & Company, Limited, Lynton Works, Bedford. It shows at a glance the multiplicity of screw threads, as no fewer than 60 types are illustrated, and 16 screws from 21 countries are indexed with appropriate reference to national standards. This folder is available to readers on writing to Bedford.

Fork Trucks. A catalogue issued by Ransomes & Rapier Limited, Waterside Works, Ipswich, deals with a new type of fork-lift truck provided with a slewing mast for long loads. It operates both for forward lifting and side carrying and handles loads of over 5 tons at 24 in. from the face of the fork. Those interested should write to Waterside Works for a copy of the catalogue.

Moulding Machines. Foundry Equipment, Limited, Linslade Works, Leighton Buzzard, have recently issued leaflet No. 146 to describe and illustrate two new machines, each made in two sizes for use with 24 by 18 in. maximum box sizes. The J.P.M. is a fully automatic moulding machine, whilst the N.A.J. is of similar appearance but carries a valve system by which each separate operation is manually controlled. The leaflet is available to readers on writing to Linslade Works.

Direct-arc Melting Furnaces. Metalectric Furnaces, Limited, Smethwick, Birmingham, have just issued a 12-page splendidly illustrated brochure covering a range of three-phase direct-arc melting furnaces. Two facing pages are particularly interesting, as they carry illustrations of 1-ton, 30-cwt., 3-, 4-, 15-, 25-, 30-, and 40-ton installations, the captions giving the power ratings and the use to which the plants are put. Stress is placed on design rather than on performance; the latter, as is well known, varies with the material to be made, and the skill of the operating staff. The brochure is obtainable on application to Smethwick.

Electro-magnetic Vibrating Equipment. Fraser & Chalmers Engineering Works, Erith, Kent, of the General Electric Company, Limited, have prepared an interesting well-illustrated 24-page brochure covering the Sherwen vibrating equipment. This publication (No. 481) tells the reader just how the vibration system operates and illustrates a number of industrial applications including one in the foundry industry. Here the Sherwen is shown receiving a mixture of hot sand and runners and risers from the knock-out. The brochure is available to readers on writing to Erith or Magnet House, Kingsway, London, W.C.2.

Air Conditioning and Air Treatment. Brightside Heating & Engineering Company, Limited, Ecclesfield, Sheffield, have issued a 24-page well-illustrated brochure, which it was expected would deal with foundry problems. Instead, there are stories of palaces and kitchens in the Middle East, chocolate, clothing and furniture factories, research laboratories, hospitals, cinemas, canteens, hairdressing saloons, all of which have been air conditioned. In addition, the brochure does illustrate a foundry amenities block. Recipients of this interesting review of Brightside's many activities will realize that they cater for many industries and organizations other than foundry.

New Patents

(Copies of complete specifications are obtainable from the Patent Office Sales Branch, 25, Southampton Buildings, Chancery Lane, London, W.C.2, price 3s.)

745,702. Regie Nationales des Usines Renault, 8-10 Avenue Emile Zola, Billancourt, Seine, France.

Patterns for precision moulding of the lost-wax type, which can be eliminated in the hot state. They are made of material constituted of mixtures of nylon and an aromatic sulphonamide, *e.g.* paratoluene-sulphonamide, $CH_3C_6H_4SO_2NH_2$.

745,769. Kaiser Aluminium and Chemical Corporation, 1924 Broadway, Oakland, California, USA.

The treatment of light metals and alloys. The patent relates particularly to the treatment of molten light metals and alloys prior to casting to provide metals free or substantially free of gas and other non-metallic impurities.

745,898. William Jessop and Sons Limited, Brightside Works, Sheffield.

Alloys of the following constituents in amounts by weight as stated: Carbon up to 0.15; nickel 20 to 26; chromium 11 to 15; cobalt 0 to 2; niobium and/or tantalum 0.2 to 0.8; molybdenum 2.3 to 3.3; and titanium 1.5 to 2.5 per cent. Iron and usual impurities comprise the balance. Usual oxidizers such as manganese, silicon, calcium and aluminium may be present but not more than 3 per cent. Such alloys may be solution treated in the temperature range 1,000 deg. C.-1,250 deg. C. and age hardened in the temperature range 600 to 750 deg. C.

745,928. O. Axmann, and A. Axmann, Vogelsanger Strasse 260, Koln-Ehrenfeld, Germany, trading as Maschinenfabrik Axman, Kommandit-Gesellschaft.

An impeller-ramming machine by which the sand is fed positively without deflection past the impeller and is thrown in a compact stream into the moulds, preferably without substantial turbulence in the apparatus. Quite often impeller rammers tend to act like sand-blasting machines, and the new process is claimed to reduce the wear and tear.

745,938. Aluminium Company of America, Alcoa Building, Pittsburgh, Pennsylvania, USA.

Duplex aluminium-base alloy products and articles in the form of high-strength aluminium-base alloys provided with an adherent protective coating of an aluminium-base alloy on one or both surfaces.

745,950. Deutsche Edelstahlwerke Aktiengesellschaft, 578 Gladbacherstrasse, Krefeld, Germany.

Permanently magnetizable alloys and the production of them described and claimed in patent No. 734,597.

745,968. Glacier Metal Company Limited, Alperton, Wembley, Middlesex.

Improved shell-moulding apparatus of the type in which the investment mixture is contained in a bin which is inverted over a patternplate and then re-inverted to allow excess investment material to fall from the plate, leaving only a thin shell thereon.

746,091. Shell Cast Alloys Limited, Victoria Road, Guelph, Ontario, Canada.

A method for backing shell moulds in moulding boxes for the shell-moulding process. A magnetic field is produced in the vicinity of the assembled mould in the moulding box and particulate magnetic backing material is placed in the moulding box whilst maintaining the magnetic field. The space between the outer surface of the mould and the wall of the moulding box is filled with ferrous shot.

746,112. Walworth Company, 430 Summer Street, Boston, 10, Massachusetts, USA.

Apparatus for assembling thermosetting-adhesive-coated sections of shell-type moulds.

746,212. Aktiengesellschaft Fur Unternehmunger der Eisen und Stahlindustrie, Altendorfstrasse, 103, Essen, Germany.

A sintered, heavy-metal alloy having a specific gravity of at least 17.5 and preferably 18.0 to 18.5 gm. per cc., in particular for clock pendulums. The alloy consists of tungsten as the main constituent with nickel 1 to 3, and copper 1.5 to 5 per cent. The copper should exceed the nickel content. The size of grain of the majority of the tungsten should be at least 15.

746,274. Aktiebolaget Kanthol, Hallstahammar, Sweden.

Thermo-electric elements in which the negative component is formed of an alloy having a base of nickel and silicon. It is characterized by having a silicon content from 1.5 to 3 per cent. and a content from 0.01 to 2 per cent. of one or more of the metals, cobalt, iron, titanium, zirconium, tantalum, copper, chromium, tungsten, molybdenum, the alkaline-earth metals, and the rare-earth metals for the purpose of moderately influencing the thermo-electric force, with or without manganese in a quantity of up to 3 per cent. The remainder is nickel.

746,309. Griffin Metal Company, 410 North Michigan Avenue, Chicago, Cork County, Illinois, USA.

Apparatus for forming a riser cup with a riser-cup opening to a mould section. A plug is loosely inserted in the opening and there is provided means for holding the plug centred and spaced from the sides of the opening. A supporting member has a surface corresponding to the contour of the article to be cast for closing the bottom end of the riser opening. A support is provided for the mould section, and the supporting member is made to urge against the surface of the casting cavity.

746,406. Mond Nickel Co. Ltd., Sunderland House, Curzon Street, London, W.1.

An addition-agent for molten iron for the purpose of introducing magnesium into the iron as cast and thereby causing some or all of the graphite in grey cast iron to be present in a spheroidal form. The agent consists of magnesium from 10 to 25, calcium from 3 to 14, iron not exceeding 30, and rare-earth metal from 0 to 8 per cent. The balance apart from impurities being silicon. The ratio of magnesium to calcium should be between 1.3 : 1 and 5.5 : 1.

746,414. Friebacher Chemische Werke Aktiengesellschaft, Friebach, Karnten, Austria.

Pyrophoric alloys, which, apart from impurities, consist (by weight) of titanium 8 to 45, zirconium 25 to 60 per cent., with antimony and bismuth, the combined contents of which should be at least 25 per cent.

746,451. Ernst Brunhuber, 94 Adalbertstrasse, Munich, 13, Germany.

A copper-base alloy, in particular for the production of chill-mould castings. It should consist of tin 4 to 10, zinc 4 to 7, silicon 1 to 6, manganese 1 to 5, and lead 0 to 3 per cent. The remainder, at least 75 per cent., however, should be copper. Additions of aluminium 0.05 to 0.7, phosphorus 0.01 to 0.2 per cent. or iron 1.5 to 3, or 0.01 to 6 per cent. of potassium, sodium, and lithium are also claimed.

746,471. M.A.F. Societe Civile D'Etudes Pour Materiel de Fonderie, 150, Rue des Blains, Bagneux (Seine), France.

Casting and stripping machines and particularly such machines as are adapted to perform the casting

New Patents

and the stripping of heat-engine pistons which are formed internally with a pair of opposed bosses forming bearings for supporting a gudgeon pin by which the piston is pivotally coupled to the connecting rod.

746,472. William Jessop and Sons, Limited, Brightside Works, Sheffield.

Alloys for manufacture of articles which, in use, are subjected to high temperatures. They consist of carbon 0.15 to 0.45, manganese 0.5 to 1.5, silicon 0.15 to 0.75, chromium 15 to 23, nickel 13 to 28, cobalt 22 to 28 (or alternatively, 0, nickel and cobalt together not exceeding 45), boron 0.002 to 0.04, tungsten 0.5 to 3.5, molybdenum 0.5 to 3.5, niobium 0.5 to 3.5, titanium 0.5 to 3.5, vanadium 0.5 to 3.5, the total of these last five elements being 5 to 10 per cent., with at least two of them being present. Iron and usual impurities comprise the balance.

746,477. Ludwig Weber, Homburger-Strasse, 6, Berlin-Wilmersdorf, Germany.

Process for the production of steel without a reduction process in the blast furnace. Ore and a solid or liquid fuel are intimately admixed and subjected to a heat-treatment at temperatures within the range of from 800 to 1,150 deg. C. for the carbonization of the fuel and partial or complete reduction of the ore. The mixture is subsequently charged to a Siemens-Martin furnace.

746,594. Gutehoffnungshutte Stekrade Aktiengesellschaft, (22a), Oberhausen (Rheinland) Germany.

A method and apparatus for the treatment of cast iron for the production of a graphite or spheroidal condition. A reagent consisting of pure magnesium or an alloy having at least 40 per cent. magnesium content is introduced into the melt or bath of cast iron to be treated from an apparatus arranged outside the treatment vessel. One or more points of introduction are located at the bottommost or lowermost part of the side wall of the treatment vessel. The reagent is introduced in small quantities controlled in accordance with the desired characteristics of the iron to be produced, while preventing a reaction of explosive violence upon the introduction of the liquid reagent.

746,712. Herman Sauter and Wilhelm Hahn, trading as Hahn ünd Kolb, Stuttgart, Germany.

Improvements in die-casting apparatus of the "cold-chamber" type in which the molten metal is introduced in the pressure chamber or "shot sleeve" which is disposed substantially perpendicular to the parting face of a two part die. It is then forced out of the chamber under high pressure by a plunger through a gate in the cover die to fill a die cavity formed between the cover and ejector dies of which the two-part die is composed.

746,754. C. Coke, "Highclyffe," 2, Kidmore Road, Caversham, Reading, Berks.

Improvements in apparatus for casting highly-refractory metals in which oxidation of metal, and change in the percentage of metals in an alloy, are prevented by the use of insert gas pressure before, and during solidification.

746,799. Griffin Wheel Company, 410, North Michigan Avenue, Chicago, County Cook, Illinois, USA.

This invention refers to a method of reducing (even to about 10 per cent. of the normal time) the melting time of a charge of ferrous metal or an alloy in a metallurgical furnace such as an open-hearth or electric type.

Company News

PULSOMETER ENGINEERING COMPANY, LIMITED—Arrangements are being made to market the ordinary shares of the company, which is a subsidiary of Camp Bird, Limited. In its new form the capital of Pulsometer Engineering will consist of £560,000 in 5s. ordinary shares and £11,100 in 5 per cent. preference of £100 denomination.

BIRMID INDUSTRIES, LIMITED—The company has received acceptances for 791,344 of the 799,167 £1 shares offered to shareholders at 45s. each. Over 1,300 applications were made for 411,310 excess shares. The basis of allotment for these shares is as follows:—Up to five shares, in full; six to 300 shares, five shares; 301 to 5,000, 10; over 5,000, 20. Allotment letters have been posted.

DERITEND STAMPING COMPANY, LIMITED—The board is increasing its final ordinary dividend by 5 per cent. to 17½ per cent., making, with the unchanged interim, a total of 22½ per cent., less tax, for the year ended February 29, 1956, compared with 17½ per cent. previously. Combined profit for the year has jumped from £292,895 to £457,467, and net profit, after taxation, etc., is up from £101,940 to £178,894.

JOHNSON & PHILLIPS, LIMITED, manufacturing electrical engineers, cablemakers, etc., of London, S.E.7—The directors have now decided to raise the new capital by an issue of unsecured loan stock instead of in shares. Owing to market conditions, they state, it is not desirable to raise the money required by an issue of share capital at present. Preference and ordinary shareholders, registered on April 24, are therefore offered £1,800,000 5½ per cent. unsecured loan stock, 1971-1976, at a price of 97, payable as to 10 per cent. by May 24, 40 per cent. by June 7, and 47 per cent. by July 5. Net proceeds of the issue, estimated at £1,720,000, will be used to repay bank overdraft and provide working capital.

Increases in Capital

P. I. CASTINGS (ALTRINCHAM), LIMITED, increased by £15,000, in £1 ordinary shares, beyond the registered capital of £20,000.

BARNET INSTRUMENTS, LIMITED, Barnet (Herts), increased by £24,250, in £1 ordinary shares, beyond the registered capital of £2,250.

EXPRESS LIFT COMPANY, LIMITED, London, S.W.1, increased by £100,000, in £1 unclassified shares, beyond the registered capital of £500,000.

FOUNDRY SERVICES (HOLDINGS), LIMITED, Birmingham, increased by £100,000, in £1 shares, beyond the registered capital of £100,000.

FRENCHAY, LIMITED, ironfounders, etc., of Bath, increased by £10,000, in £1 ordinary shares, beyond the registered capital of £50,000.

ASTON CHAIN & HOOK COMPANY, LIMITED, Birmingham, increased by £200,000, in £1 shares, beyond the registered capital of £100,000.

HUNTSPILL ENGINEERS, LIMITED, Bridgwater (Somerset), increased by £14,900, in £1 ordinary shares, beyond the registered capital of £100.

PARK ENGINEERING (FREEMANTLE), LIMITED, Southampton, increased by £10,000, in £1 ordinary shares, beyond the registered capital of £5,000.

Changes of Name

Among the companies which have recently changed their names are those listed below. The new titles are given in parentheses.

NAWORTH COLLIERIES COMPANY, LIMITED, Prudential Chambers, Bank Street, Carlisle (Naworth Lime Works, Limited).

CHURCHILL-REDMAN, LIMITED, machine-tool makers, of Walnut Tree Walk, Lambeth North, London, S.E.11 (C. Redman & Sons, Limited).

COLVERN HOLDINGS, LIMITED, electrical and mechanical engineers, etc., of Mawneys Road, Romford, Essex (Colvern, Limited).

Personal

Mr. EUSTACE C. HOLROYDE has joined the board of Lightalloys, Limited.

Mr. R. A. DUFF has been appointed works director of Parker Foundry (1929), Limited, Tropenas Steel Works, Derby.

Mr. A. BOYES has been appointed to the board of the East Sussex Engineering Company, Limited, Lewes, Sussex, and will act as director and general manager of the company.

Mr. LEWIS HART, publicity manager of the Brush Electrical Engineering Company, Limited, Loughborough, has been elected vice-chairman of the publicity committee of the British Electrical and Allied Manufacturers' Association.

The export sales manager of Ferranti, Limited, Mr. FRANK ROSTRON, has been elected a director of Manchester Royal Exchange. He is president of the Manchester Chamber of Commerce and has been closely associated with its engineering and metals section as chairman.

Dr. R. A. WILKINS, vice-president, research and development, Revere Copper & Brass Inc., Rome, N.Y., USA, has been elected a Fellow of the Institute of Metals in recognition of his outstanding services to the Institute, in particular as corresponding member to the Council in the United States.

On July 1, Sir HARRY PILKINGTON, a former president of the Federation of British Industries, is to assume the chairmanship of the National Advisory Council on Education for Industry and Commerce in succession to Lt.-Gen. Sir RONALD WEEKS, who is relinquishing the chairmanship of Vickers, Limited, shortly.

Mr. A. ELSON, chief industrial safety consultant of Samuel Fox & Company, Limited, Stocksbridge, Sheffield, is to retire. Mr. Elson was made MBE in 1953 for his services to first aid and industrial safety, and was recently elected a life member of the Sheffield Area Industrial Group, on which he has served for 11 years.

Mr. R. A. PITTMAN, B.COM.(HONS.), A.C.I.S., has been appointed secretary of the British Engineers' Association. For the past eight years, Mr. Pittman has been head of the economic research division of the Association. He succeeds Brigadier J. V. TOPHAM whose resignation has been accepted on his taking another appointment.

Mr. J. R. ROBINSON, chief engineer to Henry Meadows, Limited, Wolverhampton, is making a tour of the Far and Middle East, during which he will visit customers in Pakistan, India and Egypt. While in India he is to visit Automotive Products of India, Limited, which recently ordered £1,000,000 worth of diesel engines from the Wolverhampton firm.

After receiving the Freedom of Aberdeen on June 5, Lord BILSLAND will go on to Aberdeen University to receive the honorary degree of LL.D. Last year Lord Bilsland resigned from the chairmanship of the executive committee of the Scottish Council (Development and Industry), although he remained president. He is associated with several companies and is a director of Colvilles and John Brown & Company.

The Birmingham Medal, the highest award of the Institution of Gas Engineers, is to be presented later this month to Sir HAROLD SMITH, chairman of the Gas Council, it was announced on May 17 by the Council of the Institution. The medal was instituted in 1881 to encourage the extension of the uses of coal gas and it goes to Sir Harold in recognition of his distinguished career as a chartered gas engineer and of his services to the gas industry.

Members of the management and staff of Newton, Chambers & Company, Limited, Thorncliffe, near Sheffield, presented a mahogany writing desk made by two of the company's craftsmen, Mr. A. Whitham and Mr. R. Windle, to Sir HAROLD WEST to mark his retirement from the post of managing director. Mr. R. S. Goodhind, Thorncliffe's personnel officer, presided at the ceremony at which Mr. J. N. Cumberbirch, an 84-year-old retired member of the staff, paid tribute on behalf of the retired staff.

Obituary

The death has occurred of Mr. WALTER F. CRITTALL, a director of the Crittall Manufacturing Company, Limited, makers of metal windows, etc., of Braintree (Essex).

Mr. M. G. S. SWALLOW, formerly managing director of the Hartlepool works of Richardsons, Westgarth & Company, Limited, marine and turbine engineers and boilermakers, has died at the age of 81.

Mr. CLAUDE FIELD, a director of G. Clancey, Limited, engineers and ironfounders, of Belle Vale, Halesowen, Birmingham, who had been associated with the firm for 26 years, died on May 8, aged 53 years.

The death has occurred of Mr. WILFRED U. HODSON, chief cashier for more than 13 years, of Dorman Long & Company, Limited, Middlesbrough. Mr. Hodson, who was 66, had spent all his working life with the company.

The death has occurred of Mr. WILLIAM MCGILL, who, until ill-health led to his retirement in 1953, was a director of Balfour, Beatty & Company, Limited, electrical, mechanical, and civil engineering contractors, of London, E.C.4, and of the parent company, the Power Securities Corporation, Limited.

The death occurred on Sunday at the age of 81 of the Hon. GEOFFRY LAWRENCE PARSONS, chairman of the Parsons Marine Steam Turbine Company, Limited. The second son of the fourth Earl of Rosse, he graduated in 1897 and entered the Parsons Marine Turbine Company, of which he became a director in 1911. He was elected Prime Warden of the Worshipful Company of Shipwrights in 1951.

Chairman and managing director for the past 36 years of Samuel Taylor & Sons (Brierley Hill), Limited, Mr. HUMPHREY GEORGE TAYLOR died on May 9, at the age of 73. A grandson of the founder of the firm, he had been in the chain and chain-cable industry for more than 51 years and was responsible for the development of the electrically-welded forged-steel process of chain making. Mr. Taylor was awarded the C.B.E in 1955.

ORDERS for rolling stock placed by the British Transport Commission under the railways modernization plan included a contract with the Metropolitan-Cammell-Carriage & Wagon Company, Limited, for 500 30-ton bogie bolster wagons and not 50 as stated in our last issue.

News in Brief

NEW PREMISES are being erected for Lakeside Ironworks, Limited, Dagenham (Essex), at Becontree.

R. B. TENNENT, LIMITED, has had plans approved to erect extensions to Whifflet Foundry, Coatbridge, Lanarkshire.

AJAX MACHINE TOOL COMPANY, LIMITED, bench machine tools, of Halifax, have received an American order for ten large radial drilling machines.

FIELDEN ELECTRONICS, LIMITED, Beehive Foundry, Manchester, have appointed A. R. Bolton, Limited, 72, Haymarket Terrace, Edinburgh 12, to be their sole Scottish agents.

SAMUEL SMITH & SONS LIMITED, Beehive Foundry, Brewery Street, Smethwick, have recently had shower baths installed at a cost of £1,000. Individual private lockers have also been provided.

WOLF ELECTRIC TOOLS, LIMITED, have purchased the property adjacent to their Birmingham sales and service branch at 47, Barker Street, Birmingham, 19, for the purpose of expanding the existing showroom.

PRODUCTION of brakes at the Cwmbran (Mon) works of Girling, Limited, is expected to rise from 70,000 to 100,000 a week under a £2,000,000 expansion and modernization scheme which is nearing completion.

A TOTAL of 63 years with Ashmore, Benson, Pease & Company, Stockton-on-Tees, has been completed by Mr. Robert Blackburn, a loam mould and core maker employed at the Bowesfield Lane foundry, who is 77.

SUNDERLAND SHIPBUILDING DRY DOCKS & ENGINEERING COMPANY, LIMITED, have taken control of the Wear Winch & Foundry Company, Limited, Commercial Road, Sunderland, and this concern is now part of the group.

IN A COMPETITION for house journals, organized by the British Association of Industrial Editors, *Ingot*, the quarterly magazine of Richard Thomas & Baldwins, Limited, came first in its class—gaining the award of excellence.

MR. DUNCAN BAILEY, chairman of Charles Roberts & Company, Limited, railway wagon builders, of Horbury Junction, near Wakefield, officially opened a new £25,000 office block on May 11 to mark the centenary of the company.

INDUSTRY IN BRITAIN is losing nearly 20,000,000 man-days a year as a result of industrial accidents, states a report of the Industrial Safety Sub-committee of the National Joint Advisory Council. Every day about 60,000 people are absent from work as a result of industrial injury.

DEMAG, the German iron and steel concern, is raising its dividend for 1955 to 10 per cent., compared with 9 per cent. for the previous year. Orders in hand are estimated at DM. 800,000,000, compared with a turnover of over DM. 500,000,000 last year, of which exports accounted for 54.5 per cent.

THE GROWING VOLUME of imports, particularly of scrap cargoes, to the River Wear is reflected in the River Wear Commissioners' plan to spend £120,000 on four extra cranes and grabs at Sunderland as part of a scheme, which it has prepared to improve port and harbour facilities, involving a total of £168,410.

ALREADY THIS YEAR nearly 150 students have enrolled for the two-year course which is part of the graduate training scheme run by the Institution of Works Managers, in conjunction with the technical colleges, covering production, planning, human relations, and personnel management. Evening studies are supplemented by visits to factories.

A NUMBER of Sheffield apprentices received kits of tools appropriate to their trade at a civic service at St. James's Church, Norton, on Sunday, May 13. Nicholas Stones made a bequest for this purpose in 1676, and the apprentices who must live in the ancient parish of Norton were handed their kits by the rector halfway through the service.

AS FROM JUNE 1, the trading activities of Siemens Electric Lamps & Supplies, Limited, are being integrated with those of the parent company, Siemens Bros. & Company, Limited, which states that the move is in order to facilitate administration, to prepare for further development of business, and to increase the scope for efficient handling.

DEGENHARDT & COMPANY, LIMITED, 32, Maddox Street, London, W.1, have been appointed United Kingdom agents for the Zeiss Company. A new instrument being made available is the Technoscope—a stereoscopic microscope, to which a camera can be fitted, mounted on a portable rollable stand. It is used to detect cracks and other defects.

SIR ARTHUR CROFT, head of Crofts (Engineers), Limited, power transmission engineers, of Bradford, has donated £5,000 towards the sum of £45,000 required to provide a new "Cinderella Home" at Hest Bank, Morecambe. It will replace the present home, built in 1914, with a guarantee life of 20 years, which is still in use as a holiday home for Bradford children. About 800 children from poorer Bradford homes have had a fortnight's holiday there each year.

A BIRLEC LECTROMELT FURNACE for making steel castings is to be supplied to the corporation Minera de Bolivia at Catavi, Bolivia (an enterprise owned by the Bolivian Government). The furnace—of 3-ton capacity with a rating of 1,500 kva—is to be built 12,280 ft. above sea level and will almost certainly be the highest melting-furnace installation in the world. At this elevation, cooling of the various motors and ancillary equipment is less efficient than at normal levels and consequently special precautions are to be taken.

BIRMINGHAM EXCHANGE AND ENGINEERING CENTRE is taking a stand at the Vienna Trade Fair this year in the hope of providing small- and medium-size firms with the opportunity to display their products. Mr. Anthony Cox, general manager of the Centre, is going to Vienna for the occasion. It is believed there is a considerable market for engineering goods there and the Centre is making contact with appropriate trade associations and other organizations in Austria, as well as sending personal invitations to buyers to visit the stand. Near the Centre's stand will be the official Board of Trade exhibit.

NOTICES OF DISMISSAL have been received by 180 workers employed by Dartmouth Auto Castings, Limited, Smethwick, one of the Birmid Industries group. According to a statement by an official of the firm, the break in production of the Massey-Harris-Ferguson tractors, and a contraction in the demand for castings generally in the motor trade, accentuated by the strike at the Standard Motor Company, has led to the abandonment of double-shift working at No. 1 foundry of the company. Full-time working on a single shift will be resumed by the rest of the workers. Dartmouth Auto Castings employ approximately 1,000 operators.

TWW
foundry supplies
& sundries
MOULDERS' SUNDRIES . FOUNDRY COKES and COAL DUST . PIG IRONS, FOUNDRY and FORGE MOULDING SAND . GANISTER LIMESTONE and FLUORSPAR . BRUSHES, SIEVES and RIDDLES . TONGS, SHANKS and LADLES. These, and all items connected with the Foundry Trade, can be supplied by Ward's FOUNDRY SUPPLIES DEPARTMENT.
★ Write for a copy of our booklet — "Foundry Equipment and Supplies."
THOS. W. WARD LTD · ALBION WORKS · SHEFFIELD
TELEPHONE 26311 (22 LINES) · TELEGRAMS "FORWARD SHEFFIELD"
LONDON OFFICE: BRETTENHAM HOUSE · LANCASTER PLACE · STRAND · W.C.2
FS/29

British Electrical Power Convention & Exhibition

The British Electrical Power Convention and Exhibition opened yesterday at Torre Abbey Meadows, Torquay, and will terminate on May 29. As automation is under the earnest consideration of all engaged in industry, it is perhaps fitting that an all-electric economy house should be included in the exhibition to demonstrate the advances already made in the domestic field. Details of some of the exhibits in the industrial section in which foundrymen and vitreous enamellers would be interested are set out briefly below:—

AUSTIN CROMPTON PARKINSON ELECTRIC VEHICLES, LIMITED, 95 to 99, Ladbroke Grove, London, W.11, electric vehicles stand A.103.—This firm are showing their Morrison Electricar industrial-type road vehicle.

ELECTRIC LAMP MANUFACTURERS' ASSOCIATION, Lighting Service Bureau, 2, Savoy Hill, London, W.C.2, stand A.507.—The important part played by good lighting in modern transport forms the theme of the E.L.M.A. Lighting Service Bureau stand.

D.P. BATTERY COMPANY, LIMITED, Bakewell, Derbyshire, electric vehicles stand A.102.—Suitable for all types of battery-operated vehicles, trucks and locomotives, Kathanode traction cells are the main feature on the stand of the D.P. Battery Company, Limited.

A. REYROLLE & COMPANY, LIMITED, Hebburn, Co. Durham, stand A.401.—This firm are showing a representative selection of their new class-J range of rural switchgear units, comprising both extensible and non-extensible oil-switches and oil-immersed fuse-switches for 11-kv. service.

BELLING & COMPANY, LIMITED, Bridge Works, Southbury Road, Enfield, Middx, stand A.211.—Standard electric cookers, including those fitted with auto-timer devices, are featured on this stand, including cookers in coloured finishes, shown for the first time at the Ideal Home Exhibition.

FERRANTI, LIMITED, Hollinwood, Lancs, stand A.304.—Prominent among exhibits shown by Ferranti is a display of electric fires, a demonstration of the latest type of Fridge-Heater, a pictorial display with scale models of various sizes of power transformers and a d.c. watt-hour meter for traction use.

JACKSON ELECTRIC STOVE COMPANY, LIMITED, 143, Sloane Street, London, S.W.1, stand A.309.—Jackson's "390" range of cookers, which were introduced this Spring, is being featured, together with the Cookalone auto-control splash panel, prototypes of which were shown at the Ideal Home Exhibition.

GENERAL ELECTRIC COMPANY, LIMITED, Magnet House, Kingsway, London, W.C.2, stand A.509.—The full range of household appliances on the stand includes vacuum cleaners, superspeed kettles, and Cosyglo fires. Other items include decorative lighting fittings and Osram tubes and lamps.

ENGLISH ELECTRIC COMPANY, LIMITED, Marconi House, Strand, London, W.C.2, stand A.405.—This display is confined to three main groups of photographs representing respectively generation, distribution and utilization, together with a subsidiary photographic display dealing with domestic appliances.

CROMPTON PARKINSON, LIMITED, Crompton House, Aldwych, London, W.C.2, stand A.101.—Crompton Parkinson's traction exhibits principally comprise representative examples of their latest traction-motor and generator equipment, but the display also includes a selection of lamps, batteries and cables as used by transport undertakings.

MONSANTO CHEMICALS, LIMITED, 8, Waterloo Place, London, S.W.1, stand W.18.—The two groups of products featured in this company's display will be Pyroclor and Aroclors, fire-resistant transformer cooling fluid and capacitor impregnants; and Lustrex polystyrene which has notable applications in the manufacture of electrical equipment.

REVO ELECTRIC COMPANY, LIMITED, Tipton, Staffs, stand A.510.—The theme on the Revo stand is "Colour in the Kitchen" and a range of completely new appliances is on show. Two new automatic electric kettles are being displayed, the "Savoy" in heavy chromium plated copper with black moulded handle and the "Cumberland" in polished aluminium with red handle.

HOOVER, LIMITED, Perivale, Greenford, Middx, stand A.306.—On the Hoover stand, in addition to a range of cleaners, is a newly introduced version of their MARK III washing machine incorporating an electric water heater. The display is completed by exhibits of fractional horse-power motors and commutators, including examples of their shaded pole motors and stator-rotor units.

W. T. HENLEY'S TELEGRAPH WORKS COMPANY, LIMITED, 95, Aldwych, London, W.C.2, stand A.203.—In keeping with the main theme of the exhibition—Electricity and Transport—Henley's are featuring cables recently developed and manufactured, to include those for railway work, including power and control cables, dock and harbour cables and transport cables both large and small.

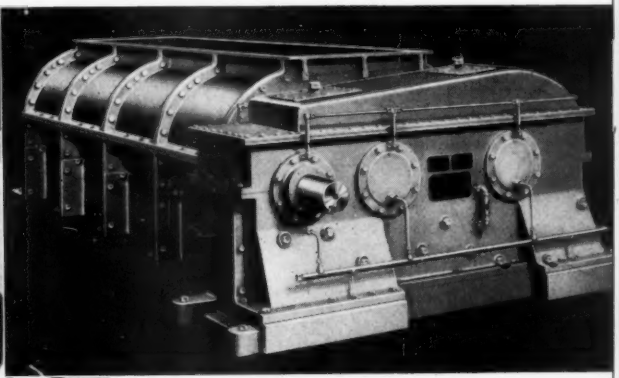
METROPOLITAN-VICKERS ELECTRICAL COMPANY, LIMITED, Trafford Park, Manchester, 17, stand E.6.—Electric traction is featured on this stand where scale models of the Metropolitan-Vickers Bo-Bo and Co-Co locomotives operating on the Manchester-Sheffield electric line, are shown. A scale model of a gas-turbo-electric locomotive for British Railways—Western Region—is also on view.

HARBOROUGH CONSTRUCTION COMPANY, LIMITED, Harbilt Works, Market Harborough, Leics, electric vehicles stand A.106.—Although not actually exhibiting, this firm are loaning one of their fork-lift trucks for general use before and after the exhibition, and this vehicle is displayed on the electric vehicle section. The model being shown is the Harbilt pedestrian controlled fork-lift truck. It can lift 1,120 pounds up to 9 ft. in 25 seconds.

HENRY WIGGIN & COMPANY, LIMITED, Thames House, Millbank, London, S.W.1, stand A.403.—A range of products indicating the wide use of nickel and nickel alloys in the generation of electrical power and in the field of electrical engineering generally, are on view on this stand. Exhibits of particular interest are a model of a Ruston & Hornsby "A" gas-turbine generator and an actual Rover-Rotax 1S/60 portable gas-turbine generator which gives a nominal output of 40 kva. Other exhibits show the application of the Brightray series of nickel-chromium electrical resistance alloys.

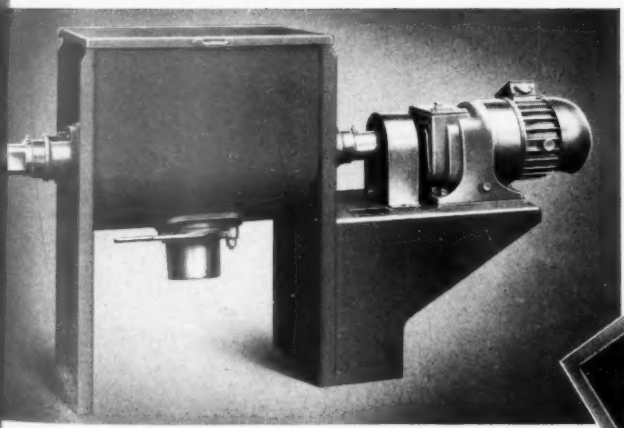
MARCO REFRIGERATORS, LIMITED, Manor Works, Streatham Vale, London, S.W.16, stand A.204.—This firm believe that the 1956 demand for refrigeration will be influenced by (*a*) compliance with Food Hygiene Regulations No. 1906 being enforced on July 1, 1956, (*b*) the increasing demand for refrigerated display, and (*c*) the demand for quick-frozen food for the sale of which refrigeration is essential. In the first category they have on show their Victor, Carlton and Astoria 25 models. In the second category they are exhibiting the Monarch frozen-food display cabinet and in category three a 6 ft. Woking display counter and a 6 ft. counter top display unit.

FOUNDRY EQUIPMENT —
Batch and Continuous Sand Mixers



CONTINUOUS MIXERS

As made and installed by Baker Perkins, U.S.A. in America's largest foundries.
Built in standard sizes with continuous outputs of 6 tons to 120 tons per hour of thoroughly aerated and homogeneously mixed moulding sand.



The Characteristic Simplex blade design.

ATCH MIXERS Made in a variety of sizes.

BAKER PERKINS LTD
Engineers
WESTWOOD WORKS – PETERBOROUGH

Raw Material Markets

Iron and Steel

Most foundries were closed for the Whitsun holiday until yesterday (Wednesday) morning, and during the break repairs to plant and cupolas were carried out. Although the recent increase in the prices of foundry pig-iron and hematite is not expected to have any material affect on demands, the foundries using refined irons and also Scotch foundry iron, which is being sent to some foundries in the English Midlands and further south, are faced with a much bigger price increase, and this may tend to curb the demand for these grades. In addition to the price increase, Scotch iron has also to bear the recent advance in railway freight charges which is payable by the consumer, whereas the prices of the other grades of iron are on either a delivered station or works basis. Whether the resultant increase in the price of castings which is bound to ensue will reduce the volume of business remains to be seen, but many producers of castings are already suffering from the affects of credit restrictions, etc., and they view with alarm any further measures likely to interfere with their trade.

Many of the engineering foundries are very busy and are absorbing available supplies of low- and medium-phosphorus foundry pig-iron as well as appreciable tonnages of hematite. While the engineering foundries catering mainly for the motor vehicle trade are steadily employed, business shows no appreciable improvement. Production of high-phosphorus pig-iron remains on a reduced scale due to the pressure for supplies of basic pig-iron from the steelworks. Overall supplies are sufficient to meet demands, but some producers are already fully covered for their outputs and there is little room for expansion should the need arise. The jobbing foundries are fairly busy. The light foundries, although steadily engaged, have plenty of capacity for more work.

The re-rollers maintain production at a good level and there is a persistent call for light sections, small bars, strip, etc. The supply of steel billets on hand enables re-rollers to work without interruption, but in many instances stocks are being used up rather fast. Outputs of the re-rolling mills are almost entirely utilized by home consumers and fresh orders are coming to hand regularly. Good business is also on offer from overseas buyers, but there is little tonnage to spare for them.

Non-ferrous Metals

Trading in London continues to be featureless and, indeed, little in the way of excitement could be expected before the holiday break. In copper, interest appears to be more concerned with prospects for the future than in immediate conditions. The conjecture about the outlook seems fairly evenly divided. One half of the trade feels that it will continue its downward course, pointing out that automobile production in the United States will probably not recover until September, when the new models are due to appear, general consumption is lower, and supplies are improving.

On the other hand, bullish feelings about copper are supported by the way in which the price has maintained stability in the face of the automobile cutbacks, the fact that demand is still good, that in many cases it is below actual requirements, and that labour troubles in America cannot be discounted. Looking further ahead, there is also a belief that an easing of international tension will lead to expanded sales of copper wire to the USSR.

Meanwhile, the US copper market continues to be dull and uneventful, with Custom smelters offering at 45 cents a pound and primary producers selling at 46 cents. Business in the metal beyond June remains negligible.

Tin prices continue to move according to day-to-day interpretations of the labour situation in the East. An additional factor in the market in the near future will be the international tin agreement now that Indonesia has deposited the instruments of ratification in London. Demand is good, but supplies are more than equal to the situation and an advance in price cannot be expected to emanate on this score.

Lead is a quiet market, although the offtake in the US last week of 5,112 tons shows up well against the previous week's absorption of only 3,136 tons, which was the lowest for a long time. Zinc, too, is quiet, with demand fairly good for "Prime Western" on the basis of 13¼ cents a pound. US domestic production in March totalled 46,900 tons, an increase of 4,200 tons over February and the highest since June, 1953.

Official metal prices were as follow:—

COPPER, Standard—*Cash:* May 17, £341 to £341 10s.; May 18, £343 to £343 10s.; May 22, £337 10s. to £338; May 23, £325 to £326.

Three Months: May 17, £331 to £331 10s.; May 18, £334 10s. to £335; May 22, £330 to £331; May 23, £319 10s. to £320.

TIN, Standard—*Cash:* May 17, £753 to £754; May 18, £751 10s. to £752; May 22, £750 to £752; May 23, £755 to £756.

Three Months: May 17, £753 to £755; May 18, £752 to £752 10s.; May 22, £751 to £752; May 23, £754 10s. to £755 10s.

LEAD—*Second half May:* May 17, £111 15s. to £112 5s.; May 18, £113 5s. to £113 10s.; May 22, £113 to £113 5s.; May 23, £111 10s. to £112.

Second half August: May 17, £110 5s. to £110 10s.; May 18, £111 10s. to £111 15s.; May 22, £111 5s. to £111 10s.; May 23, £109 15s. to £110 5s.

ZINC—*Second half May:* May 17, £94 15s. to £95 5s.; May 18, £95 15s. to £96; May 22, £95 5s. to £95 10s.; May 23, £93 10s. to £93 15s.

Second half August: May 17, £92 15s. to £93; May 18, £93 5s. to £93 15s.; May 22, £92 10s. to £92 15s.; May 23, £91 to £91 5s.

Simon-Carves Dividend Recommendation

The directors of Simon-Carves, Limited, coke-oven manufacturers, of Stockport (Cheshire), are recommending a final dividend of 17½ per cent., less tax, on the £1,000,000 capital for 1955. An interim dividend of 11¼ per cent. was paid on the £525,000 capital existing before the capitalization of £262,500 of reserves and the issue of 850,000 5s. shares at 22s. per share in September last. At that time the directors anticipated a final dividend of 15 per cent. For the previous year an interim of 10 per cent. was paid on £477,235, and an interim of 10 per cent. and a final of similar amount on £524,958.

Subject to Treasury consent, the directors propose to create 2,000,000 ordinary shares of 5s. each to be issued as fully paid to holders registered on June 15 in the proportion of one for two. These shares will not participate in the final dividend in respect of 1955.